Sprouts of the broccoli cultivar Everest contained 130-fold more inducer potential (units/g fresh w ight) than mature vegetables. The inducer activity in broccoli was significantly higher than in daikon.

Example 5

INDUCER POTENTIAL OF BROCCOLI SPROUT EXTRACTS

Inducer potential of a series of water extracts of 3-day old broccoli sprouts of the cultivar Saga were determined. Plants were prepared by first surface sterilizing seeds of *Brassica oleracea* variety *italica* (broccoli) cultivar Saga by a 1 min treatment in 70% ethanol, followed by 15 min in 1.3% sodium hypochlorite containing approximately 0.001% Alconox detergent. Seeds were grown in sterile plastic containers at a density of approximately 8 seeds/cm^2 for 72 hours on a 0.7% agar support that did not contain added nutrients. The environment was carefully controlled with broad spectrum fluorescent lighting, humidity and temperature control (16 hours light, 25°C / 8 hours dark, 20°C).

Plants were rapidly and gently collected from the surface of the agar to minimize glucosinolate hydrolysis by endogenous myrosinase released upon plant wounding. Sprouts (approximately 25 mg fresh wt/sprout) were gently harvested and immediately and rapidly plunged into approximately 3 volumes of boiling water in order to inactivate endogenous myrosinase as well as to extract glucosinolates and isothiocyanates from the plant tissue. Water was returned to a boil and maintained at a rolling boil for 3 min. The sprouts were then either strained from the boiled infusion [tea, soup] or homogenized in it, and the residue then removed by filtration or centrifugation.

Data in Table 3 represent both homogenates and infusions. Preparations were stored at -20°C until assayed. Inducer potential of plant extracts, prepared

Exhibit 5-D

as described above, was determined as described in Definitions section above.

TABLE 3

Inducer Potentials of Hot Water Extracts of 3-Day Saga Broccoli Sprouts

EXTRACT NO.	units/g fresh weight
1	500,000
2	370,000
3	455,000
4	333,000
5	435,000
6	333,000
7	625,000
8	250,000
9	313,000
10	357,000
11	370,000
12	370,000
13	217,000
14	222,000
15	1,000,000
16	714,000
17	435,000
18	1,250,000
19	263,000
AVERAGE	464,000 ± 61,600 S.E.M.

Some variability in the amount of Phase 2 enzyme-inducer potential was detected. High levels of Phase 2 enzyme-inducer potential, however, were consistently observed.

Example 6

HOT WATER BROCCOLI EXTRACTS TREATED WITH DAIKON MYROSINASE

QR activity in a hot water broccoli extract increased in the presence of a vegetable source of myrosinase. An aqueous extraction of 3-day old sprouts of broccoli cultivar Saga grown on water agar, in which myrosinase was inactivated by boiling for 3 min, was divided into 6 different 150 ml aliquots. Nine-day old daikon sprouts, a rich source of the enzyme myrosinase, were added to this cooled infusion in amounts equivalent to 0, 5, 9, 17, 29 and 40% (w/w) of the broccoli. QR activity, as determined in the Definition section, of the control extracts containing 0% daikon was 26,300 units/gram fresh weight while QR activity of the extracts that had received daikon as a source of myrosinase ranged from 500,000 to 833,000 units/gram fresh weight of broccoli. Accordingly, myrosinase present in the daikon sprouts, increased the QR activity in the broccoli extract greater than 19-fold.

Example 7

GLUCORAPHANIN AND GLUCOERUCIN ARE THE PREDOMINANT GLUCOSINOLATES IN HOT WATER EXTRACTS OF BROCCOLI (CULTIVAR SAGA) SPROUTS

Paired Ion Chromatography (PIC). Centrifuged hot water extracts of 3-day-old broccoli (cultivar Saga) sprouts were subjected to analytical and preparative PIC on a reverse phase C18 Partisil ODS-2 HPLC column in ACN/H_2O (1/1, by vol.) with tetraoctylammonium (TOA) bromide as the counter-ion. Only three well-separated peaks were detected: peak A eluted at 5.5 min, B at 11.5

min, and C at 13 min at a molar ratio [A:B:C] of ca. 2.5 : 1.6 : 1.0 (monitored by UV absorption at 235 nm), and they disappeared if the initial extracts were first treated with highly purified myrosinase. Peaks A, B, and C contained no significant inducer activity, and cyclocondensation assay of myrosinase hydrolysates showed that only Peaks A and C produced significant quantities of isothiocyanates, accounting for all the inducer activity. See Zhang *et al.*, *Anal. Biochem.* 205: 100-107 (1992). Peak B was not further characterized. Peaks A and C were eluted from HPLC as TOA salts but required conversion to ammonium salts for successful mass spectroscopy, NMR and bioassay. The pure peak materials were dried in a vacuum centrifuge, redissolved in aqueous 20 mM NH_4Cl, and extracted with chloroform to remove excess TOA bromide. The ammonium salts of glucosinolates remained in the aqueous phase, which was then evaporated.

Identification of Glucosinolates. The ammonium salts of Peaks A and C were characterized by mass spectrometric and NMR techniques: (a) negative ion Fast Atom Bombardment (FAB) on a thioglyerol matrix; this gave values of 436 (Peak A) and 420 (Peak C) amu for the negative molecular ions, and (b) high resolution NMR, as shown in Figure 2, provided unequivocal identification of the structure. Peak A is glucoraphanin [4-methylsulfinylbutyl glucosinolate], and Peak C is the closely related glucoerucin [4-methythiobutyl glucosinolate]. These identifications and purity are also consistent with the inducer potencies; Peaks A and C, after myrosinase hydrolysis had potencies of 36,100 and 4,360 units/μmol, respectively, compared with reported CD values of 0.2 μM (33,333 units/μmol) for sulforaphane and 2.3 μM (2,900 units/μmol) for erucin. CD values are the concentrations of a compound required to double the QR specific activity in Hepa 1c1c7 murine hepatoma cells. Since there are no other glucosinolate peaks, and the inducer activity of peak A and C account for the total inducer activity of the extracts, it is

therefore likely that in this cultivar of broccoli, there are no significant quantities of other inducers, *i.e.*, no indole or hydroxyalkenyl glucosinolates. Further, the isolated compounds are therefore substantially pure.

Example 8

COMPARISON OF AQUEOUS AND ORGANIC SOLVENT TECHNIQUES FOR EXTRACTION OF INDUCER POTENTIAL

Plants were prepared by first surface sterilizing seeds of *Brassica oleracea* variety *italica* (broccoli) cultivar Saga, with 70% ethanol followed by 1.3% sodium hypochlorite and 0.001% alconox. The seeds were grown in sterile plastic containers at a density of approximately 8 seeds/cm^2 for 72 hours on a 0.7% agar support that did not contain added nutrients. The environment was carefully controlled with broad spectrum fluorescent lighting, humidity, and temperature control (16 hours light, 25°C/8 hours dark, 20°C).

The plants were rapidly and gently collected from the surface of the agar to minimize glucosinolate hydrolysis by endogenous myrosinase released upon plant wounding. A portion of the plants was homogenized with 10 volumes of the DMF/ACN/DMSO solvent at -50°C, as described in Example 1, which dissolves nearly all the non-lignocellulosic plant material. Alternatively, the bulk of the harvested plants was plunged into 5 volumes of boiling water for 3 min to inactivate endogenous myrosinase and to extract glucosinolates and isothiocyanates. The cooled mixture was homogenized, centrifuged, and the supernant fluid was stored at -20°C.

Inducer potential of plant extracts, prepared by the two methods described above, was determined by the microtiter plate bioassay as described above. Typical inducer potentials in an average of 5 preparations were 702,000 (DMF/ACN/DMSO extracts) and 505,000 (aqueous extracts) units/g fresh weight of sprouts.

Spectrophotometric quantitation of the cyclocondensation product of the reaction of isothiocyanates with 1,2-benzenedithiole was carried out as described in Zhang *et al.*, *Anal. Biochem.* 205: 100-107 (1992). Glucosinolates were rapidly converted to isothiocyanates after addition of myrosinase. About 6% of the total hot water extractable material [dissolved solids] consisted of glucosinolates. These results demonstrate that (a) isothiocyanate levels in the crude plant extracts are extremely low; (b) myrosinase rapidly converts abundant glucosinolates to isothiocyanates; (c) hot water extraction releases over 70% of the inducer activity extractable with a triple solvent mixture permitting recovery of most of the biological activity in a preparation that is safe for human consumption; and (d) over 95% of the inducing potential in the intact plant is present as glucosinolates and therefore no other inducers are present in biologically significant quantities.

Example 9

DEVELOPMENTAL REGULATION OF GLUCOSINOLATE PRODUCTION

Preliminary experiments in which field grown broccoli (cultivar DeCicco) was harvested at sequential time points from the same field indicated that on a fresh weight basis, inducer potential declined from the early vegetative stage through commercial harvest, but appeared to increase at late harvest (onset of flowering). These data suggested that inducer potential might be highest in seeds. Subsequent studies have shown that when seeds of 8 broccoli cultivars were surface sterilized and grown under gnotobiotic conditions, Phase 2 enzyme-inducer potential was highest in seeds and declined progressively (on a fresh weight basis) over time throughout the first 14 days of seedling growth.

Expressed on a per plant basis, however, activity remained constant over this period, suggesting that at

this early stage of growth there was no net synthesis of glucosinolates. However, when the glucosinolate profiles of market stage broccoli heads and 3 day old sprouts (cultivar Emperor) were compared, there was a pr found difference in the apparent glucosinolate compositions of these plants.

Sprouts were prepared by first surface sterilizing seeds of *Brassica oleracea* variety *italica* (broccoli) cultivar Emperor with a 1 minute treatment in 70% ethanol, followed by 15 min in 1.3% sodium hypochlorite with approximately 0.001% Alconox detergent. Seeds were grown in sterile plastic containers at a density of approximately 8 seeds/cm^2 for 72 hours on a 0.7% agar support that did not contain added nutrients. The environment was carefully controlled; broad spectrum fluorescent lighting, humidity and temperature control (16 hours light, 25°C / 8 hours dark, 20°C).

Plants were rapidly and gently collected from the surface of the agar to minimize glucosinolate hydrolysis by endogenous myrosinase released upon plant wounding. Sprouts [approximately 25 mg fresh wt/sprout], were gently harvested and immediately and rapidly plunged into approximately 3 volumes of boiling water in order to inactivate endogenous myrosinase as well as to extract glucosinolates and isothiocyanates from the plant tissue. Water was returned to a boil and maintained at a rolling boil for 3 min. The sprouts were then strained from the boiled infusion [tea, soup] and the infusion was stored at -20°C until assayed.

Market stage heads were obtained by germinating seeds of the same seedlot in a greenhouse in potting soil, transplanting to an organically managed field in Garrett County, MD and harvested at market stage. Heads were immediately frozen upon harvest, transported to the laboratory on ice and extracts were prepared in an identical fashion to those described above for sprouts

except that approximately 3 gram floret tissue samples were used for extraction.

Inducer potential of plant extracts, prepared as described above, was determined by the microtiter plate bioassay method as described in Example 1. Paired ion chromatography revealed two major peaks, probably glucobrassicin and neo-glucobrassicin, in extracts of market stage heads with similar retention times to glucobrassicin (indole-3-ylmethyl glucosinolate) and neo-glucobrassicin (1-methoxyindole-3-ylmethyl glucosinolate). This observation is consistent with published reports on the glucosinolate composition of mature broccoli plants. However, paired ion chromatography under the same conditions of identically prepared extracts of 3-day-old sprouts showed absence of glucobrassicin or neo-glucobrassicin. Additionally, 3-day-old sprouts of different broccoli cultivars produce different mixtures of glucosinolates. Accordingly, glucosinolate production is developmentally regulated.

Example 10

EVALUATION OF ANTICARCINOGENIC ACTIVITIES OF BROCCOLI SPROUT PREPARATIONS IN THE HUGGINS DMBA (9,10 DIMETHYL-1,2-BENZANTHRACENE) MAMMARY TUMOR MODEL

Sprouts were prepared by first surface sterilizing seeds of *Brassica oleracea* variety *italica* (broccoli) cultivar Saga with a 1 min treatment in 70% ethanol, followed by 15 min in 1.3% sodium hypochlorite with approximately 0.001% Alconox detergent. Seeds were grown in sterile plastic containers at a density of approximately 8 seeds/cm^2 for 72 hours on a 0.7% agar support that did not contain added nutrients. The environment was carefully controlled with broad spectrum fluorescent lighting, humidity and temperature control (16 hours light, 25°C / 8 hours dark, 20°C).

The plants were rapidly and gently collected from the surface of the agar to minimize glucosin late hydrolysis by endogenous myrosinase released upon plant wounding. A large quantity of sprouts was harvested by immediately and rapidly plunging into approximately 3 volumes of boiling water in order to inactivate endogenous myrosinase, as well as extracting glucosinolates and isothiocyanates from the plant tissue. Water was returned to a boil and maintained at a rolling boil for 3 min. Sprouts were then strained from the boiled infusion [tea, soup] and the infusion was lyophilized and stored as a dry powder at -20°C [designated Prep A]. Other sprouts, similarly prepared were extracted with boiling water, cooled to 25°C and were amended with a quantity of 7 day old daikon sprouts equivalent to approximately 0.5% of the original fresh weight of broccoli sprouts. This mixture was homogenized using a Brinkman Polytron Homogenizer and incubated at 37°C for 2 hours following which it was filtered through a sintered glass filter, lyophilized as above and stored as a dried powder at -20°C [designated Prep B].

QR inducer activity and inducer potential of plant extracts, prepared as described above, was determined by the microtiter plate bioassay method as described above. The induction of QR activity in preparation A is largely due to glucosinolates; predominantly glucoraphanin, which is the glucosinolate of sulforaphane, but this preparation also contains some glucoerucin, which is the sulfide analog of glucoraphanin. The induction QR activity of preparation B is almost exclusively due to isothiocyanates arising from treatment of glucosinolates with myrosinase.

Female Sprague-Dawley rats received at 35 days of age were randomized; 4 animals per plastic cage. All animals received 10 mg DMBA, by gavage in 1 ml sesame oil, at age 50 days. Sprout preparations (A or B) or vehicle control were given by gavage at 3, 2 & 1 day prior to DMBA, on

the day of DMBA (2 hr prior to the DMBA dose) and on the day following DMBA d sing. The vehicle used was 50% Emulphor 620P / 50% water. Animals were maintained on a semi-purified AIN-76A diet *ad libitum* from the time of receipt until termination of the experiment (167 days of age).

TABLE 4

ANTICARCINOGENIC ACTIVITIES OF BROCCOLI SPROUT EXTRACTS IN THE DMBA RAT MAMMARY TUMOR MODEL

GROUP	TREATMENT	NUMBER OF ANIMALS AT TERMINATION	TOTAL TUMOR NUMBER	MULTIPLICITY: NUMBER OF TUMORS PER RAT
CONTROL	DMBA only	19	34	1.79
PREPARATION A (Glucosinolate)	324 mg/dose (100 µmol sulforaphane equiv.)	18	19	1.05
PREPARATION B (Isothiocyanate)	424 mg/dose (100 µmol sulforaphane equiv.)	20	11	0.55

The development of palpable tumors was delayed for as much as 5 weeks by the administration of sprout extracts. Rats treated with either Preparation A or B had significantly fewer tumors than the untreated control, and the multiplicity of tumors (tumors per rat) was significantly lower in the animals receiving Preparations A or B.

Example 11

METABOLISM AND CLEARANCE OF GLUCOSINOLATES IN HUMANS

Two male, non-smoking volunteers ages 35 and 40 years, each in good health, were put on a low vegetable diet in which no green or yellow vegetables, or condiments, mustard, horseradish, tomatoes or papayas were consumed. After 24 hours on such a diet, all urine was collected in 8 hr aliquots. After 24 hours of baseline data, subjects ingested 100 ml of broccoli sprout soup (prepared as below), containing 520 μmol of glucosinolates.

The sprouts were prepared by first surface sterilizing seeds of *Brassica oleracea* variety *italica* (broccoli) cultivar Saga with a 1 min treatment in 70% ethanol, followed by 15 min in 1.3% sodium hypochlorite with ca. 0.001% Alconox detergent. Seeds were grown in sterile plastic containers at a density of approximately 8 seeds/cm^2 for 72 hours on a 0.7% agar support that did not contain added nutrients. The environment was carefully controlled with broad spectrum fluorescent lighting, humidity and temperature control (16 hours light, 25°C / 8 hours dark, 20°C). The plants were rapidly and gently collected from the surface of the agar to minimize glucosinolate hydrolysis by endogenous myrosinase released upon plant wounding. A large quantity of sprouts was harvested by immediately and rapidly plunged into approximately 3 volumes of b iling water in order to inactivate endogenous myrosinase as

well as to extract glucosinolates and isothiocyanates from the plant tissue. Water was returned to a boil and maintained at a rolling boil for 3 min. Following the boiling step, sprouts were homogenized directly in their infusion water for 1 min using a Brinkman Polytron Homogenizer and the preparations were frozen at -79°C until use.

Inducer potential of plant extracts, prepared as described above, was determined by the microtiter plate bioassay method as described above. Inducer potential is nearly all due to glucosinolates; predominantly glucoraphanin, which is the glucosinolate of sulforaphane, but some glucoerucin which is the sulfide analog of glucoraphanin was also present. When converted to isothiocyanates by the addition of purified myrosinase, Phase 2 enzyme-inducing potential was 100,000 units/ml and contained 5.2 μmol of isothiocyanates per ml, as determined by the cyclocondensation reaction described in Example 7. Thus, the subjects consumed a total of 520 μmol of glucosinolates.

Collection of 8 hour urine samples was continued for an additional 30 hours. Urinary excretion of isothiocyanate conjugates (dithiocarbamates) was monitored using the cyclocondensation reaction as described in Example 7.

TABLE 5

EXCRETION OF DITHIOCARBAMATES BY TWO SUBJECTS INGESTING 520 MICROMOLES OF GLUCOSINOLATES EXTRACTED FROM SAGA BROCCOLI

TIME	CONDITION	SUBJECT 1	SUBJECT 2
Collection Time (hours)		µmol Dithiocarbamate per 8 hour urine collection	
8	baseline	1.4	2.7
16	baseline	2.1	0.9
24	baseline	1.7	5.4
32	1st 8 hour post-dose	23.2	20.4
40	2nd 8 hour post-dose	9.9	36.8
48	3rd 8 hour post-dose	4.4	14.0
56	4th 8 hour post-dose	4.2	4.1
Total post-dose minus average baseline:		39.8	63.2
Total as Percent of dose:		6.7%	12.2%

The two subjects studied metabolically converted a significant fraction of the ingested glucosinolates to the isothiocyanates which were converted to cognate dithiocarbamates and measured in the urine.

Example 12

EFFECTS OF PHYSICAL INTERVENTIONS ON SPROUT GROWTH ON PRODUCTION OF INDUCERS OF QUINONE REDUCTASE

Sprouts were prepared by first surface sterilizing seeds of *Raphanus sativum* (daikon) by a 1 minute treatment with 70% ethanol, followed by a 15 min treatment with 1.3% sodium hypochlorite with approximately 0.001% Alconox detergent. Seeds were grown

in sterile plastic containers at a density of approximately 8 seeds/cm^2 for 7 days on a 0.7% agar support that did not contain added nutrients. The environment was carefully controlled with broad spectrum fluorescent lighting, humidity and temperature control (16 hours light 25°C/8 hours dark, 20°C).

Treated sprouts were irradiated with germicidal UV light for 0.5 hr on days 5 and 6. Treated sprouts were only half the height of the untreated controls. Plants were harvested on day 7 by rapidly and gently collecting the plants from the surface of the agar to minimize glucosinolate hydrolysis by endogenous myrosinase released upon plant wounding. Sprouts were harvested by immediate and rapid plunging into approximately 10 volumes of DMF/ACN/DMSO (1:1:1) at approximately -50°C in order to inactivate endogenous myrosinase as well as to extract glucosinolates and isothiocyanates. Sprouts were immediately homogenized with a ground glass mortar and pestle and stored at -20°C.

Inducer potential of plant extracts, prepared as described above, was determined by the microtiter plate bioassay method as described above. Inducer potential of the UV-treated sprouts was over three times that of untreated controls. Treatment of sprouts with ultraviolet light therefore increased the Phase 2 enzyme-inducer potential of the plant tissue.

Although the foregoing refers to particular preferred embodiments, it will be understood that the present invention is not so limited. It will occur to those of ordinary skill in the art that various modifications may be made to the disclosed embodiments and that such modifications are intended to be within the scope of the present invention, which is defined by the following claims. All publications and patent applications mentioned in this specification are indicative of the

level of skill of those in the art to which the invention pertains.

All publications and patent applications are herein incorporated by reference to the same extent as if each individual publication or patent application were specifically and individually indicated to be incorporated by reference in its entirety.

What Is Claimed Is:

1. Cruciferous sprouts, with the exception of cabbage, cress, mustard and radish sprouts, harvested prior to the 2-leaf stage.

2. The cruciferous sprouts according to claim 1, wherein said sprouts are a *Brassica oleracea* selected from the group of varieties consisting of *acephala, alboglabra, botrytis, costata, gemmifera, gongylodes, italica, medullosa, palmifolia, ramosa, sabauda, sabellica, and selensia.*

3. The cruciferous sprouts according to claim 2, wherein said sprouts are a *Brassica oleracea* variety *italica.*

4. The cruciferous sprouts according to claim 1, wherein said sprouts are a *Brassica oleracea* variety *botrytis.*

5. The cruciferous sprouts according to claim 1, wherein said sprouts are a *Brassica oleracea* variety *botrytis* subvariety *cauliflora.*

6. The cruciferous sprouts according to claim 1, wherein said sprouts are substantially free of Phase 1 enzyme-inducing potential.

7. A non-toxic solvent extract of the cruciferous sprouts according to claim 1.

8. The non-toxic solvent extract according to claim 7, wherein said solvent is water.

9. The non-toxic solvent extract according to claim 8, furth r comprising a cruciferous vegetable comprising an active myrosinase enzyme.

10. The non-toxic solvent extract according to claim 9, wherein said cruciferous vegetable is of the genus *Raphanus*.

11. A method of increasing the chemoprotective amount of Phase 2 enzymes in a mammal, comprising the step of administering an effective quantity of ~~the~~ cruciferous sprouts according to claim 1.

12. Cruciferous sprouts harvested prior to the 2-leaf stage, wherein said sprouts have at least 200,000 units per gram fresh weight of Phase 2 enzyme-inducing potential when measured after 3-days of growth from seeds that produce said sprouts and non-toxic levels of indole glucosinolates and their breakdown products and goitrogenic hydroxybutenyl glucosinolates.

13. The cruciferous sprouts according to claim 12, wherein said sprouts are a *Brassica oleracea* selected from the group of varieties consisting of *acephala*, *alboglabra*, *botrytis*, *costata*, *gemmifera*, *gongylodes*, *italica*, *medullosa*, *palmifolia*, *ramosa*, *sabauda*, *sabellica*, and *selensia*.

14. The cruciferous sprouts according to claim 13, wherein said sprouts are a *Brassica oleracea* variety *italica*.

15. The cruciferous sprouts according to claim 13, wherein said sprouts are a *Brassica oleracea* variety *botrytis*.

16. The cruciferous sprouts according to claim 15, wherein said sprouts are a *Brassica oleracea* variety *botrytis* subvariety *cauliflora*.

17. A non-toxic solvent extract of the cruciferous sprouts according to claim 12.

18. The non-toxic solvent extract according to claim 17, wherein said solvent is water.

19. The non-toxic solvent extract according t claim 18, further comprising a cruciferous vegetable comprising an active myrosinase enzyme.

20. The non-toxic solvent extract according to claim 19, wherein said cruciferous vegetable is of the genus *Raphanus*.

21. A method of preparing a food product rich in glucosinolates, comprising germinating cruciferous seeds, with the exception of cabbage, cress, mustard and radish seeds, and harvesting sprouts prior to the 2-leaf stage, to form a food product comprising a plurality of sprouts.

22. The method according to claim 21, wherein said sprouts contain non-toxic levels of indole glucosinolates and their breakdown products and goitrogenic hydroxybutenyl glucosinolates.

23. The method according to claim 21, wherein said seeds are a *Brassica oleracea* selected from the group of varieties consisting of *acephala, alboglabra, botrytis, costata, gemnifera, gongylodes, italica, medullosa, palmifolia, ramosa, sabauda, sabellica*, and *selensia*.

24. The method according to claim 23, wherein said seeds are *Brassica oleracea* variety *italica*.

25. The method according to claim 23, wherein said seeds are *Brassica oleracea* variety *botrytis*.

26. The method according to claim 25, wherein said seeds are *Brassica oleracea* variety *botrytis* subvariety *cauliflora*.

27. A food product rich in glucosinolates made by the process according to claim 21.

28. A method of preparing a food product, comprising extracting glucosinolates and isothiocyanates from cruciferous sprouts according to claim 1 with a non-toxic solvent, removing the extracted sprouts from said solvent, and recovering the extracted glucosinolates and isothiocyanates.

29. A method of preparing a food product according to claim 28, wherein active myrosinase enzyme is mixed with said cruciferous sprouts, or said extracted glucosinolates and isothiocyanates, or both said cruciferous sprouts or said extract.

30. A method of preparing a food product rich in glucosinolates, comprising germinating cruciferous seeds that produce sprouts having at least 200,000 units per gram fresh weight of Phase 2 enzyme-inducing potential when measured after 3-days of growth and which contain non-toxic levels of indole glucosinolates and their breakdown products and goitrogenic hydroxybutenyl glucosinolates, and harvesting sprouts prior to the 2-leaf stage to form a food product comprising a plurality of sprouts.

31. The method according to claim 30, wherein said seeds are a *Brassica oleracea* selected from the group of varieties consisting of *acephala*, *alboglabra*, *botrytis*, *costata*, *gemmifera*, *gongylodes*, *italica*, *medullosa*, *palmifolia*, *ramosa*, *sabauda*, *sabellica*, and *selensia*.

32. The method according to claim 31, wherein said seeds are *Brassica oleracea* variety *italica*.

33. The method according to claim 31, wherein said seeds are *Brassica oleracea* variety *botrytis*.

34. The method according to claim 33, wherein said seeds are *Brassica oleracea* variety *botrytis* subvariety *cauliflora*.

35. A food product rich in glucosinolates, made by the process according to claim 30.

36. A method of preparing a food product, comprising introducing cruciferous seeds, wherein said seeds produce sprouts having at least 200,000 units per gram fresh weight of Phase 2 enzyme-inducing potential when measured after 3-days of growth and non-toxic levels of indole glucosinolates and their breakdown products and goitrogenic hydroxybutenyl glucosinolates, into another edible ingredient.

37. A method of preparing a food product, comprising extracting glucosinolates and isothiocyanates with a non-toxic solvent and isothiocyanantes from cruciferous seeds, sprouts, plants or plant parts wherein seeds that produce said sprouts, plant, or plant parts, have at least 200,000 units per gram fresh weight of Phase 2 enzyme-inducing potential when measured after 3-days of growth and wherein said seeds, sprouts, plants or plant parts have non-toxic levels of indole glucosinolates and their breakdown products and goitrogenic hydroxybutenyl glucosinolates, and recovering the extracted glucosinolates and isothiocyanates.

38. A method of preparing a food product according to claim 37, wherein active myrosinase enzyme is mixed with said cruciferous seeds, sprouts or plants; or said extracted glucosinolates and isothiocyanates; or both said cruciferous seeds, sprouts or plants and said extract.

39. A method of reducing the level of carcin gens in a mammal, comprising administering to a mammal an

effective amount of cruciferous sprouts, with the exception of cabbage, cress, mustard and radish sprouts.

40. A method of reducing the level of carcinogens in a mammal, comprising administering to a mammal an effective amount of cruciferous sprouts having at least 200,000 units per gram fresh weight of Phase 2 enzyme-inducing potential when measured after 3-days of growth from seeds that produce said sprouts and non-toxic levels of indole glucosinolates and their breakdown products and goitrogenic hydroxybutenyl glucosinolates.

41. A method of extracting glucosinolates and isothiocyanates from plant tissue comprising the steps of homogenizing said plant tissue in an excess of a mixture of dimethyl sulfoxide, acetonitrile and dimethylformamide at a temperature sufficient to inactivate myrosinase enzyme activity.

42. A food product comprising cruciferous sprouts, with the exception of cabbage, cress, mustard and radish sprouts, harvested prior to the 2-leaf stage, cruciferous seeds; extracts of said sprouts or seeds; or any combination of said sprouts, seeds or extracts.

43. A method of increasing the chemoprotective amount of Phase 2 enzymes in a mammal, comprising the step of administering an effective quantity of the food product according to claim 42.

44. A food product comprising cruciferous sprouts harvested prior to the 2-leaf stage, wherein said sprouts have at least 200,000 units per gram fresh weight of Phase 2 enzyme-inducing potential when measured after 3-days of growth from seeds that produce said sprouts and non-toxic levels of indole glucosinolate and goitrogenic hydroxybutenyl glucosinolates; cruciferous seeds; extracts of said sprouts or seeds; or any combination of said sprouts, seeds or extracts.

45. A method of increasing th chemoprotective amount of Phase 2 enzymes in a mammal, comprising the step of administering an effective quantity of the food product according to claim 44.

46. Cruciferous sprouts harvested prior to the 2-leaf stage, wherein the ratio of monofunctional to bifunctional inducers is at least 20 to 1.

47. A food product supplemented with a purified or partially purified glucosinolate.

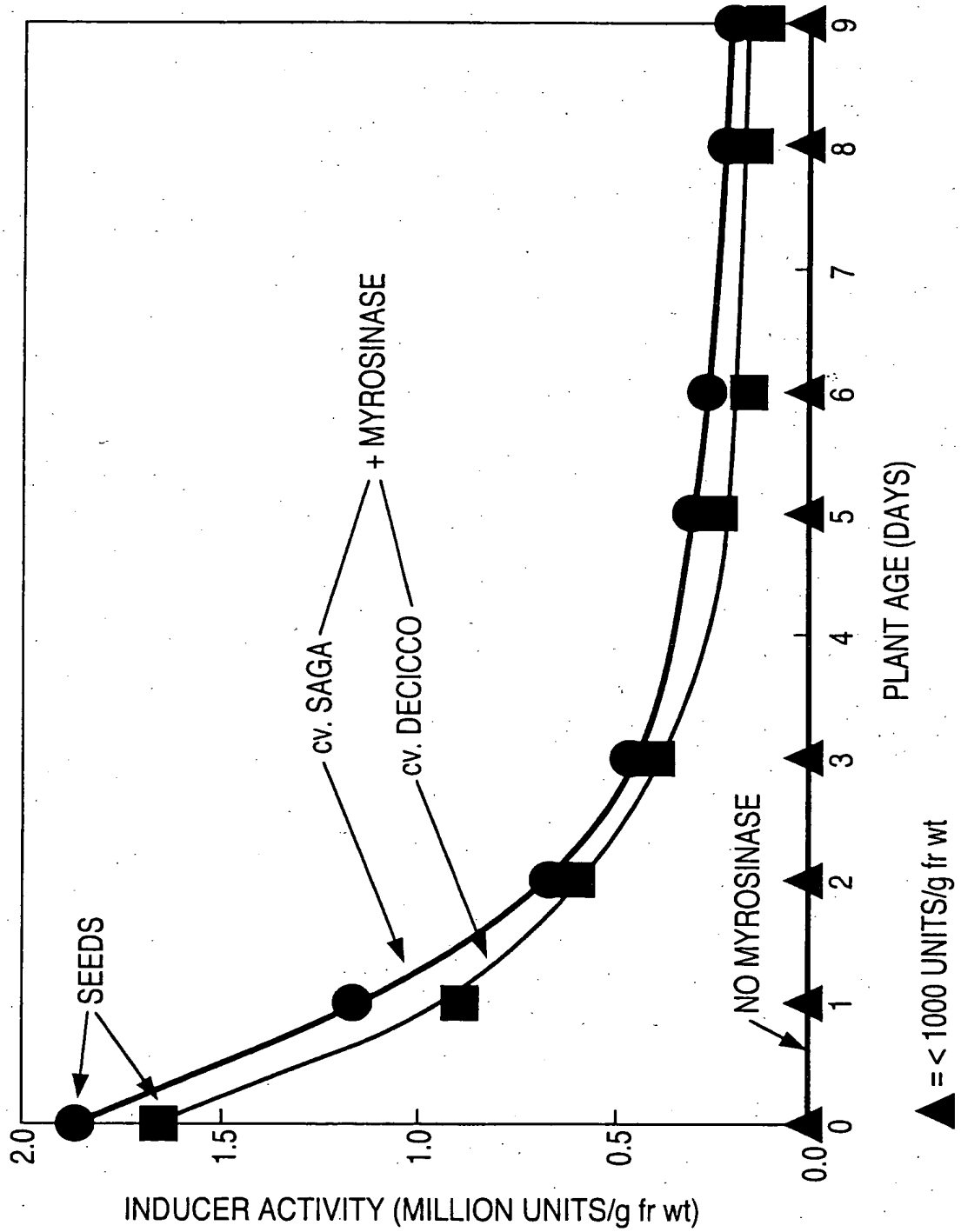
A1 Add Claims 48-67

add B3

ABSTRACT OF THE DISCLOSURE

Vegetable sources of cancer chemoprotective agents have been identified which are extraordinarily rich in glucosinolates, metabolic precursors of isothiocyanates. The vegetable sources are used to provide a dietary means of reducing the level of carcinogens in mammals.

FIG. 1


+ MYROSINASE
cv. SAGA
cv. DECICCO
SEEDS
NO MYROSINASE
2.0
1.5
1.0
0.5
0.0
0
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3
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5
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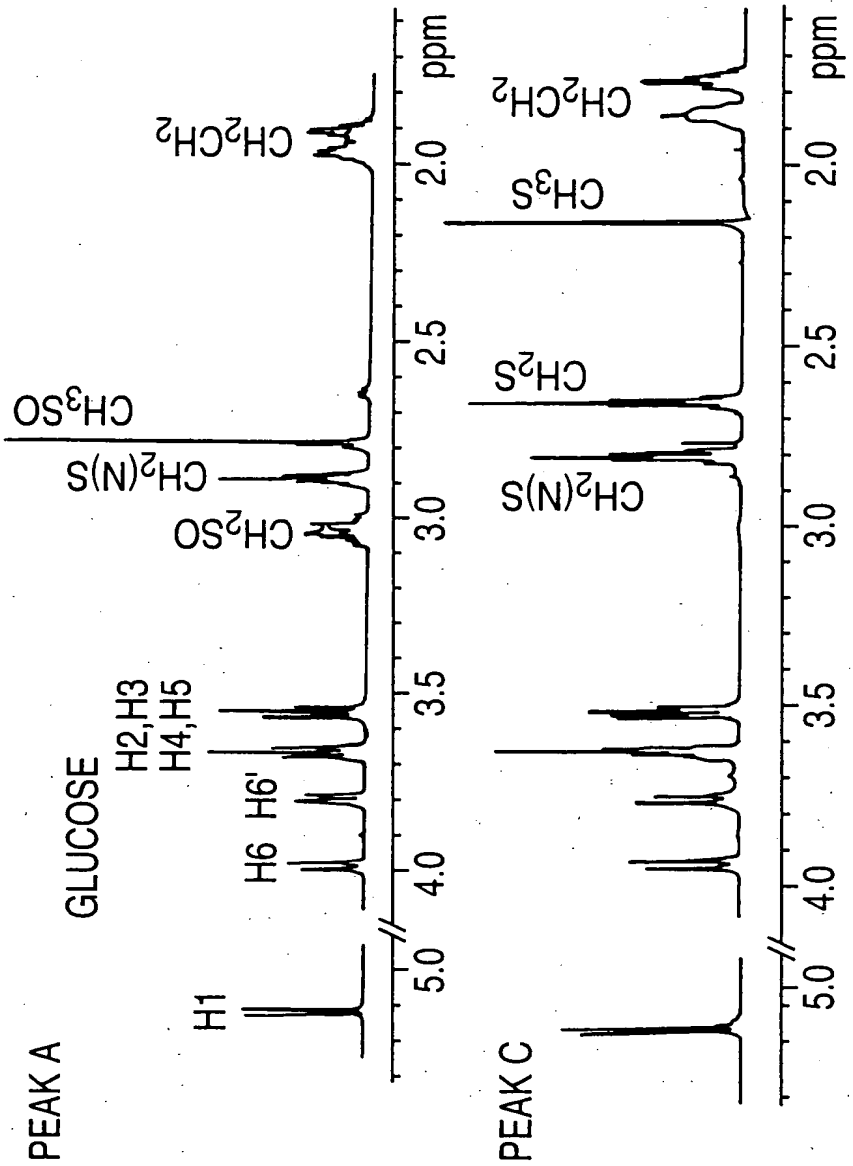
7
8
9
PLANT AGE (DAYS)
= < 1000 UNITS/g fr wt
INDUCER ACTIVITY (MILLION UNITS/g fr wt)

Title: CANCER CHEMOPROTECTIVE FOOD PRODUCTS
Inventor(s): Jed FAHEY et al.
DOCKET NO.: 046585/0138

FIG. 2



DECLARATION AND POWER OF ATTORNEY

As a below named inventor, I hereby declare that:

My residence, post office address, and citizenship are as stated below next to my name.
I believe I am the original, first and sole inventor (if only one name is listed below) or an original, first and joint inventor (if plural names are listed below) of the subject matter which is claimed and for which a patent is sought on the invention entitled:

CANCER CHEMOPROTECTIVE FOOD PRODUCTS

the specification of which (check one)

☒ is attached hereto

☐ was filed on as Application Serial No. and was amended on (if applicable).

I hereby state that I have reviewed and understand the contents of the above-identified specification, including the claims, as amended by any amendment referred to above.

I acknowledge the duty to disclose information which is known by me to be material to patentability as defined in Title 37, Code of Federal Regulations § 1.56.

I hereby claim foreign priority benefits under Title 35, United States Code, § 119 of any foreign application(s) for patent or inventor's certificate listed below and have also identified below any foreign application for patent or inventor's certificate having a filing date before that of the application on which priority is claimed:

PRIOR FOREIGN APPLICATION(S)

NUMBER	COUNTRY	DAY/MONTH/YEAR FILED	PRIORITY CLAIMED

I hereby claim the benefit under Title 35, United States Code, § 120 of any United States application(s) listed below and insofar as the subject matter of each of the claims of this application is not disclosed in the prior United States application in the manner provided by the first paragraph of Title 35, United States Code, § 112, I acknowledge the duty to disclose information which is known by me to be material to patentability as defined in Title 37, Code of Federal Regulations § 1.56 which occurred between the filing date of the prior application and the national or PCT international filing date of this application:

APPLICATION SERIAL NO.	FILING DATE	STATUS: PATENTED, PENDING, ABANDONED

I hereby appoint as my attorneys, with full powers of substitution and revocation, to prosecute this application and transact all business in the Patent and Trademark Office connected therewith: Stephen A. Bent, Reg. No. 29,768; David A. Blumenthal, Reg. No. 26,257; John J. Feldhaus, Reg. No. 28,822; Donald D. Jeffery, Reg. No. 19,980; Eugene M. Lee, Reg. No. 32,039; Peter G. Mack, Reg. No. 26,001; Brian J. McNamara, Reg. No. 32,789; Sybil Meloy, Reg. No. 22,749; George E. Quillin, Reg. No. 32,792; Colin G. Sandercock, Reg. No. 31,298; Bernhard D. Saxe, Reg. No. 28,665; Richard L. Schwaab, Reg. No. 25,479; Arthur Schwartz, Reg. No. 22,115; Harold C. Wegner, Reg. No. 25,258.

Send all correspondence to FOLEY & LARDNER, 3000 K Street, N.W., Suite 500, Washington, DC 20007-5109. Address telephone communications to *Bernhard D. Saxe* at (202) 672-5300.

I hereby declare that all statements made herein of my own knowledge are true and that all statements made on information and belief are believed to be true; and further that these statements were made with the knowledge that willful false statements and the like so made are punishable by fine or imprisonment, or both, under Section 1001 of Title 18 of the United States Code and that such willful false statements may jeopardize the validity of the application or any patent issued thereon.

Full Name of First or Sole Inventor	Signature of First or Sole Inventor	Date
Jed W. FAHEY	Jed W. Fahey	9/13/95
Residence Address: 6704 RIDGE RD., ELDERSBURG, MD 21784		Country of Citizenship: *United States*
Post Office Address: 6704 RIDGE RD., ELDERSBURG, MD 21784		

Signatures should conform to names as typewritten. ☒ Additional inventors on attached Page 2.

Full Name of Second Inventor	Signature of Second Inventor	Date
Paul TALALAY	Paul Talalay	9/13/95
Residence Address	**Country of Citizenship**	
5512 BOXHILL LANE, BALTIMORE MD 21210	*United States*	
Post Office Address		
5512 BOXHILL LANE BALTIMORE MD 21210		

#3

Atty. Dkt. No. 046585/0138

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

Applicant: Jed FAHEY et al.

Title: CANCER CHEMOPROTECTIVE FOOD PRODUCTS

Appl. No.: Unassigned

Filing Date: 04/05/2001

Examiner: Unassigned

Art Unit: Unassigned

INFORMATION DISCLOSURE STATEMENT UNDER 37 CFR §1.56

Commissioner for Patents
Box PATENT APPLICATION
Washington, D.C. 20231

Sir:

Applicants submit herewith on Form PTO-1449 a listing of the documents cited by or submitted to the U.S. PTO in parent application Serial No. 09/425,890, filed 11/25/1999. As provided in 37 CFR §1.98(d), copies of the documents are not being provided since they were previously submitted to the United States Patent & Trademark Office in the above-identified parent application.

The submission of any document herewith, which is not a statutory bar, is not intended as an admission that such document constitutes prior art against the claims of the present application or that such document is considered material to patentability as defined in 37 CFR §1.56(b). Applicants do not waive any rights to take any action which would be appropriate to antedate or otherwise remove as a competent reference any document which is determined to be a *prima facie* art reference against the claims of the present application.

Atty. Dkt. No. 046585/0138

TIMING OF THE DISCLOSURE

The listed documents are being submitted in compliance with 37 CFR §1.97(b), within three (3) months of the filing date of the application.

RELEVANCE OF EACH DOCUMENT

Applicants respectfully request that any listed document be considered by the Examiner and be made of record in the present application and that an initialed copy of Form PTO-1449 be returned in accordance with MPEP §609.

The Commissioner is hereby authorized to charge any additional fees which may be required regarding this application under 37 C.F.R. §§ 1.16-1.17, or credit any overpayment, to Deposit Account No. 19-0741. Should no proper payment be enclosed herewith, as by a check being in the wrong amount, unsigned, post-dated, otherwise improper or informal or even entirely missing, the Commissioner is authorized to charge the unpaid amount to Deposit Account No. 19-0741.

Respectfully submitted,

Date: April 5, 2001

By _____

Richard C. Peet
Attorney for Applicant
Registration No. 35,792

FOLEY & LARDNER
Washington Harbour
3000 K Street, N.W., Suite 500
Washington, D.C. 20007-5109
Telephone: (202) 672-5483
Facsimile: (202) 672-5399

002.563678.1

CLAIMS ONLY

SERIAL NO. 09825981 | FILING DATE

APPLICANT(S)

CLAIMS

	AS FILED		AFTER 1st AMENDMENT		AFTER 2nd AMENDMENT	
	IND.	DEP.	IND.	DEP.	IND.	DEP.
1						
2						
3						
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48	1					
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50		1				
TOTAL IND.						
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TOTAL CLAIMS						

	*		*		*	
	IND.	DEP.	IND.	DEP.	IND.	DEP.
51		1				
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55		1				
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TOTAL IND.	2					
TOTAL DEP.	18					
TOTAL CLAIMS	20					

* MAY BE USED FOR ADDITIONAL CLAIMS OR AMENDMENTS

FORM PTO-2022 (1-98)

U.S. DEPARTMENT OF COMMERCE
Patent and Trademark Office

*U.S. Government Printing Office: 1998 - 433-214/70303

PATENT APPLICATION SERIAL NO. _____

U.S. DEPARTMENT OF COMMERCE
PATENT AND TRADEMARK OFFICE
FEE RECORD SHEET

04/09/2001 DTESSEM1 00000044 09825989
01 FC:201 355.00 OP

PTO-1556
(5/87)

*U.S. GPO: 1998-459-082/10144

PATENT APPLICATION FEE DETERMINATION RECORD
Effective October 1, 2000

Application or Docket Number

CLAIMS AS FILED - PART I

	(Column 1)	(Column 2)
TOTAL CLAIMS	20	
FOR	NUMBER FILED	NUMBER EXTRA
TOTAL CHARGEABLE CLAIMS	20 minus 20=	* 0
INDEPENDENT CLAIMS	2 minus 3 =	* 0
MULTIPLE DEPENDENT CLAIM PRESENT		☐

* If the difference in column 1 is less than zero, enter "0" in column 2

SMALL ENTITY TYPE ☑		OR	OTHER THAN SMALL ENTITY	
RATE	FEE		RATE	FEE
BASIC FEE	355.00	OR	BASIC FEE	710.00
X$ 9=		OR	X$18=	
X40=		OR	X80=	
+135=		OR	+270=	
TOTAL	355	OR	TOTAL	

CLAIMS AS AMENDED - PART II

AMENDMENT A

	(Column 1) CLAIMS REMAINING AFTER AMENDMENT		(Column 2) HIGHEST NUMBER PREVIOUSLY PAID FOR	(Column 3) PRESENT EXTRA
Total	*	Minus	**	=
Independent	*	Minus	***	=
FIRST PRESENTATION OF MULTIPLE DEPENDENT CLAIM				☐

SMALL ENTITY		OR	OTHER THAN SMALL ENTITY	
RATE	ADDITIONAL FEE		RATE	ADDITIONAL FEE
X$ 9=		OR	X$18=	
X40=		OR	X80=	
+135=		OR	+270=	
TOTAL ADDIT. FEE		OR	TOTAL ADDIT. FEE	

AMENDMENT B

	(Column 1) CLAIMS REMAINING AFTER AMENDMENT		(Column 2) HIGHEST NUMBER PREVIOUSLY PAID FOR	(Column 3) PRESENT EXTRA
Total	*	Minus	**	=
Independent	*	Minus	***	=
FIRST PRESENTATION OF MULTIPLE DEPENDENT CLAIM				☐

RATE	ADDITIONAL FEE		RATE	ADDITIONAL FEE
X$ 9=		OR	X$18=	
X40=		OR	X80=	
+135=		OR	+270=	
TOTAL ADDIT. FEE		OR	TOTAL ADDIT. FEE	

AMENDMENT C

	(Column 1) CLAIMS REMAINING AFTER AMENDMENT		(Column 2) HIGHEST NUMBER PREVIOUSLY PAID FOR	(Column 3) PRESENT EXTRA
Total	*	Minus	**	=
Independent	*	Minus	***	=
FIRST PRESENTATION OF MULTIPLE DEPENDENT CLAIM				☐

RATE	ADDITIONAL FEE		RATE	ADDITIONAL FEE
X$ 9=		OR	X$18=	
X40=		OR	X80=	
+135=		OR	+270=	
TOTAL ADDIT. FEE		OR	TOTAL ADDIT. FEE	

* If the entry in column 1 is less than the entry in column 2, write "0" in column 3.
** If the "Highest Number Previously Paid For" IN THIS SPACE is less than 20, enter "20."
***If the "Highest Number Previously Paid For" IN THIS SPACE is less than 3, enter "3."
The "Highest Number Previously Paid For" (Total or Independent) is the highest number found in the appropriate box in column 1.

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

REQUEST FOR REEXAMINATION OF PATENT NUMBER: 5,725,895 ISSUED: March 10, 1998 INVENTORS: Jed W. Fahey and Paul Talalay ASSIGNEE: Johns Hopkins School of Medicine FOR: METHOD OF PREPARING A FOOD PRODUCT FROM CRUCIFEROUS SEEDS	TECH. CENTER: 1761 (Formerly Group Art Unit: 1302) EXAMINER: L. WONG

POWER OF ATTORNEY

The Sproutman, Inc. ("Sproutman"), a Pennsylvania corporation located at 1415 Chestnut Ridge Road, Upper Black Eddy, PA 18972, hereby appoints Carla J. Dolce, Reg. No. 33,681, an attorney licensed to practice law in the State of Texas; to represent it in all respects in connection with the above-referenced Request for Reexamination ("Request") including full power of substitution and revocation, power to make alterations and amendments to the Request, to transact all business in the U.S. Patent and Trademark Office in connection with the Request, and to be served with all papers, notice or process in connection therewith.

I, Murray Tizer, declare that I am President of The Sproutman, Inc. and have authority to grant the power granted herein, that all statements made herein are true and were made with the knowledge that willful false statements and the like so made are punishable by fine or imprisonment, or both, under Section 1001 of Title 18 of the United States Code.

Murray Tizer

Murray Tizer, President of The Sproutman, Inc.
Date: 10-6-99

Sheet 1 of 1

Form PTO-1449	U.S. Dept. of Commerce Patent and Trademark Office	Attorney Docket No.: 5121.02	Patent No.: 5,725,895
INFORMATION DISCLOSURE CITATION (Use several sheets if necessary)		Patentee: Jed W. Fahey and Paul Talalay Assignee: Johns Hopkins School of Medicine	
		Issue Date: March 10, 1998	Group Art Unit: 1302 Examiner: L. Wong

Initial	REF	OTHER ART (Including Author, Title, Date, Pertinent Pages, Etc.)
	A	Meyerowytz, Steve, *Sprout It! One Week From Seed To Salad*, 4th ed. 1993, The Sprout House, Inc., P. O. Box 1100, Great Barrington, MA 01230. Pgs. i-viii, 1-31, 54-127, 152-54, 171-176.
	B	Meyerowytz, Steve, *Growing Vegetables Indoors*, 1990, The Sprout House, Inc., P. O. Box 1100, Great Barrington, MA 01230. Entire book, especially pgs. 5-10, 32, 55, 62, 63 and 71.
	C	Munroe, Esther, *Sprouts To Eat And Grow*, 1974, The Stephen Greene Press, Brattleboro, VT. Pgs. 1-41.
	D	Oliver, Martha H., *Add A Few Sprouts To Eat Better For Less Money*, 1975, Keats Publishing, Inc., 36 Grove St., New Canaan, CT 06840. Pgs. 7-9, 42-71, 118-119.
	E	Tobe, John H., *Sprouts Elixir Of Life*, Sixth Printing, August 1976, The Provoker Press, St. Catharines, Ont., Canada. Pgs. 9-59, 73-83.
	F	Wigmore, Ann, *The Sprouting Book*, 1986, Avery Publishing Group, Inc., Wayne, NJ. Pgs. v-viii, 1-59, 75-83.
	G	Whyte, Karen Cross, *The Complete Sprout Cookbook*, 1973 (2d printing), Troubador Press, San Francisco, CA. Pgs. 1-63.
	H	Schmidt, James C., *"Growing Sprouts Indoors,"* 1984, Cooperative Extension Services, University Of Illinois at Urbana-Champaign, College of Agriculture. All of two page pamphlet.
	I	Schwarze, Debra, *"Growing Sprouts,"*, 1989, Cooperative Extension Service, Institute of Agriculture and Natural Resources, University of Nebraska-Lincoln. All of two page pamphlet.
	J	The Sprout House, Advertising Brochure from The Sprout House, 40 Railroad Street, Great Barrington, MA 01230, 1988. Entire brochure.
	K	*The Sprout Letter*, May-June 1981 Issue (No. 4). All, especially pgs. 3, 5.

EXAMINER	DATE CONSIDERED

*EXAMINER: Initial if references considered, whether or not citation is in conformance with MPEP 609; Draw line through citation if not in conformance and not considered. Include copy of this form with next communication to applicant.

IN THE UNITED STATES DISTRICT COURT

FOR THE DISTRICT OF DELAWARE

BRASSICA PROTECTION PRODUCTS, LLC and JOHNS HOPKINS UNIVERSITY Plaintiffs, v. THE SPROUTMAN INC. and MURRAY TIZER Defendants.	)	Civil Action No.

COMPLAINT FOR PATENT INFRINGEMENT

Plaintiffs, Brassica Protection Products, LLC and Johns Hopkins University, by and through their undersigned counsel, file this Complaint against Defendants, The Sproutman Inc. and Murray Tizer, averring as follows:

NATURE OF THE ACTION

1. This is an action for patent infringement arising under the Patent Laws of the United States, in particular 35 U.S.C. §§ 271, 283, 284 and 285.

THE PARTIES

2. Plaintiff, Brassica Protection Products, LLC ("Brassica"), is a Limited Liability Company organized and existing under the laws of Delaware, having a place of business at 600 East Lombard St., Suite 522, Baltimore, Maryland, 21202.

3. Plaintiff, Johns Hopkins University ("Johns Hopkins"), is a corporation organized and existing under the laws of Maryland, having a principal place of business at 33rd St. and Charles St., Baltimore, Maryland, 21218.

EXHIBIT 3

5-D36

4. Upon information and belief, defendant, The Sproutman Inc. ("Sproutman"), is a corporation organized and existing under the laws of the Commonwealth of Pennsylvania, having a place of business at 1415 Chestnut Ridge Rd., Upper Black Eddy, Pennsylvania, 18972.

5. Upon information and belief, defendant Murray Tizer is the President and Chief Executive Officer of Sproutman, which has a place of business at 1415 Chestnut Ridge Rd., Upper Black Eddy, Pennsylvania, 18972.

JURISDICTION AND VENUE

6. This court has jurisdiction over the subject matter of this action under 28 U.S.C. § 1338(a).

7. Venue is proper in this district court pursuant to 28 U.S.C. §§ 1391(b) and (c), and 1400(b).

8. Upon information and belief, defendants are doing business in the State of Delaware and have committed and/or induced others to commit acts of infringement in the State of Delaware. Upon information and belief, this Court has personal jurisdiction over Sproutman and Murray Tizer

THE PATENT

9. On March 10, 1998, United States patent 5,725,895 ("the '895 patent") entitled "Method Of Preparing A Food Product From Cruciferous Seeds" was duly and legally issued to Johns Hopkins as assignee of the inventors Jed W. Fahey and Paul Talalay, M.D. A copy of the '895 patent is attached as Exhibit A.

10. Plaintiff Brassica is the exclusive licensee under the '895 patent, and under the terms of its license, Brassica has the right to sue to enjoin any and all infringement of the

'895 patent and to recover damages caused by such infringement. Further, the U.S. Government has a paid-up license under the '895 patent and the right in limited circumstances to require the patent owner to license others on reasonable terms as provided for by the terms of grant PO1 CA 44530, entitled "Novel Strategies for Chemoprotection Against Cancer," awarded by the National Cancer Institute, Department of Health and Human Services.

11. Dr. Talalay is the John Jacob Abel Distinguished Service Professor at the Johns Hopkins University School of Medicine, a member of the National Academy of Sciences of the U.S.A. and the American Philosophical Society. He is also a Fellow of the American Academy of Arts and Sciences and was appointed a life-time Professor of the American Cancer Society. Mr. Fahey is a plant physiologist in the Department of Pharmacology and Molecular Sciences at The Johns Hopkins University School of Medicine. Before joining the Johns Hopkins faculty, he spent 15 years in the biotechnology industry and held senior management positions in agricultural biotechnology research and process development.

12. The invention of the '895 patent is based, in part, upon Dr. Talalay's life-long study of cancer and pursuit of edible plants that have a chemoprotective effect against cancer. Chemoprotection is a means for preventing cancer by increasing the body's own cancer-fighting defense mechanisms by administration of anti-cancer agents delivered, ideally, in the diet. Chemoprotection takes advantage of the ability of cells of the human body to produce a family of detoxification enzymes that neutralize highly reactive and dangerous forms of cancer-causing chemicals before those chemicals can damage DNA and initiate the process that can lead to malignancy. By inducing the production of these detoxification enzymes in the body, protection against cancer can be achieved.

13. Dr. Talalay and colleagues have received worldwide acclaim for their discovery that certain varieties of vegetables, such as broccoli, contain natural chemical agents that are potent inducers of cellular detoxification enzymes that protect against cancer-causing chemicals.

14. Based upon these discoveries, Dr. Talalay founded the Brassica Chemoprotection Laboratory at Johns Hopkins University with support from, inter alia, the National Cancer Institute. The mission of this laboratory was to examine the chemoprotective properties of plants and to ensure that consumption of the most promising vegetables by humans is both safe and effective.

15. Dr. Talalay's examination of the chemoprotective properties of plants was initially focused on mature, market stage vegetables, such as broccoli. However, Dr. Talalay and Mr. Fahey discovered that the concentrations of cancer-fighting enzymes in cruciferous plants are considerably higher during the sprout stage than at later stages of development. They discovered that sprouts of cruciferous seeds, such as broccoli sprouts, can be selected to produce food products that are rich in glucosinolates. Glucosinolates are precursors of chemicals that induce production of cancer-fighting enzymes in the body.

16. Dr. Talalay and Mr. Fahey were awarded the '895 patent for their important discovery. The '895 patent discloses and claims a novel method of preparing a food product which involves germinating certain cruciferous seeds, such as broccoli seeds, and harvesting the sprouts prior to the 2-leaf stage to produce a food product that is rich in glucosinolates.

17. The invention disclosed in the '895 patent has received widespread acclaim in the scientific literature, the popular press and the broadcast media. Dr. Talalay's and

Mr. Fahey's discovery was published in the prestigious scientific journal, *Proceedings of the National Academy of Science of the U.S.A.* on September 16, 1997, and has been the subject of scientific commentary as well as numerous newspaper, magazine, radio and television reports.

18. The importance of the '895 invention also has been recognized by the sprout-growing industry and the public. Prior to the publication of that work in the *Proceedings of the National Academy of Science*, broccoli sprouts were not being grown commercially, nor had they been recognized as a rich source of the cancer chemoprotective compounds. However, within days of that publication in September 1997, broccoli sprouts began to appear in the supermarkets and health food stores.

19. Plaintiff, Brassica, was founded, inter alia, to make Dr. Talalay's and Mr. Fahey's important discovery available to the public. Brassica markets broccoli sprouts rich in glucosinolates that are grown under exacting, hygienic standards. A portion of the proceeds from the product are donated to The Brassica Foundation for Chemoprotection Research Inc. of Baltimore Maryland. The purpose of this foundation is to support research on chemoprotection against cancer by scientists.

COUNT 1

20. The allegations contained in Paragraphs 1 through 19 are incorporated herein by reference as though fully set forth.

21. Upon information and belief, defendant Sproutman has been and now is infringing the '895 patent under 35 U.S.C. § 271(a) and/or (b) by making, using, offering to sell and/or selling and/or actively inducing others to make, use, offer to sell and/or sell the patented invention of the '895 patent. Upon information and belief, Sproutman has known about the '895

patent since at least June 4, 1998. Upon information and belief, Sproutman's infringing activities have been willful and will continue unless enjoined by this Court.

22. Upon information and belief, defendant Sproutman has for a time past and still is infringing and/or inducing infringement of the '895 patent by selling broccoli sprouts utilizing the patented inventions to customers in Delaware through intermediaries and will continue to do so unless enjoined by this Court. Upon information and belief, Sproutman's broccoli sprouts have been in the past and are being sold at, inter alia, Harvest Market, 1252 Old Lancaster Pike, Hockessin, Delaware and the Newark Co-op Natural Foods, 280 E. Main Street, Newark, Delaware.

23. Upon information and belief, defendant Sproutman has profited by its infringing activities; Brassica and Johns Hopkins have been damaged by those infringing activities and will be irreparably injured unless those infringing activities are enjoined by this Court. Brassica and Johns Hopkins do not have an adequate remedy at law.

COUNT 2

24. The allegations contained in Paragraphs 1 through 23 are incorporated herein by reference as though fully set forth.

25. Upon information and belief, defendant Murray Tizer has been and now is infringing the '895 patent under 35 U.S.C. § 271(b) by actively inducing others to make, use, offer to sell and/or sell the patented invention of the '895 patent. Upon information and belief, Murray Tizer has known about the '895 patent since at least June 4, 1998. Upon information and belief, Murray Tizer's infringing activities have been willful and will continue unless enjoined by this Court.

26. Upon information and belief, defendant Murray Tizer has for a time past and still is infringing and/or inducing infringement of the '895 patent by selling broccoli sprouts utilizing the patented inventions to customers in Delaware through intermediaries and will continue to do so unless enjoined by this Court. Upon information and belief, Murray Tizer's broccoli sprouts have been in the past and are being sold at, inter alia, Harvest Market, 1252 Old Lancaster Pike, Hockessin, Delaware and the Newark Co-op Natural Foods, 280 E. Main Street, Newark, Delaware.

27. Upon information and belief, defendant Murray Tizer has profited by his infringing activities; Brassica and Johns Hopkins have been damaged by those infringing activities and will be irreparably injured unless those infringing activities are enjoined by this Court. Brassica and Johns Hopkins do not have an adequate remedy at law.

WHEREFORE, Brassica and Johns Hopkins respectfully request that this Court enter the following relief:

A. A judgment that Sproutman and Murray Tizer have infringed the '895 patent and that their infringement has been willful;

B. A preliminary and permanent injunction enjoining Sproutman, its officers, agents, servants, employees, and attorneys, including defendant Murray Tizer, and those persons in active concert or participation with them who receive actual notice of the order by personal service or otherwise, from any further infringement of the '895 patent;

C. A judgment in favor of Brassica and Johns Hopkins for its damages caused by defendants' infringement and that those damages be trebled and awarded to Brassica and Johns Hopkins with prejudgment interest;

D. A judgment in favor of Brassica and Johns Hopkins for its attorneys fees, costs, and expenses in this action; and

E. A judgment in favor of Brassica and Johns Hopkins for such further necessary proper relief as this Court may deem just.

MORRIS, NICHOLS, ARSHT & TUNNELL

Jack B. Blumenfeld (# 1014)
1201 North Market Street
P.O. Box 1347
Wilmington, DE 19899-1347
(302) 658-9200

OF COUNSEL:

E. Anthony Figg
Joseph A. Hynds
ROTHWELL, FIGG, ERNST & KURZ, P.C.
Suite 701 East Tower
555 Thirteenth Street, N.W.
Washington, DC 20004
(202) 783-6040

Dated: June 4, 1999

122555

Hortus Third

A Concise Dictionary of Plants Cultivated in the United States and Canada

Initially Compiled by
LIBERTY HYDE BAILEY
and ETHEL ZOE BAILEY

Revised and Expanded by
THE STAFF OF THE
LIBERTY HYDE BAILEY HORTORIUM

A Unit of the
New York State College of Agriculture and Life Sciences
a Statutory College of the
State University at Cornell University

Volume One
A-K

Willd.; *Statice pseudarmeria* J. Murr.]. Resembling *A. maritima*, but with lvs. broader, lanceolate, to 10 in. long, ¼ in. wide, 5–7-nerved, margins narrowly scarious; involucral sheath to 4 in. long; fls. white to dark rose-pink. Portugal. The commonly cult. broad-lvd. thrift.

rigida: *A. plantaginea.*

Rouyana Daveau. To 1 ft., forming mats; lvs. filiform or linear, channelled, 1-nerved, to 4 in. long; interfloral bracts pubescent at least on basal half, usually as long as or longer than calyx tube, calyx spur more than half as long as calyx tube, calyx hairy on and between ribs, fls. rose-pink. Portugal.

rumelica Boiss. Lvs. stiff, 3–5-nerved, of 2 kinds, outer lvs. broadly linear, shortly acuminate, inner lvs. narrowly linear; fls. purplish-pink. Balkan Pen.

ruscinonensis: *A. maritima.*

setacea: see *A. juncea*. Var. **alba:** a listed name, probably referring to *A. juncea* cv.

sibirica: *A. maritima.*

splendens: *A. juniperifolia.*

stenophylla: *A. plantaginea.*

Sundermanii: a listed name of no botanical standing, used for a form of *A. maritima.*

vulgaris: *A. maritima.* Vars. **nana** and **splendens:** listed names of no botanical standing, used for forms of *A. maritima.*

Walterana: a listed name of no botanical standing.

Welwitschii Boiss. [*A. Welwitschii* var. *stenophylla* Daveau]. Tufted, subshrubby, to 1 ft., glabrous, somewhat glaucous; lvs. linear, to 4 in. long, channelled or flat, obscurely 1-nerved; fls. pink, calyx with basal spur. Portugal.

Willkommiana: *A. maritima.*

→ **ARMORACIA** P. Gaertn., B. Mey. & Scherb. *Cruciferae.* About 3 spp. of glabrous per. herbs, with deep roots or rhizomes, native to Eur. and Asia; lvs. simple to pinnatifid, basal lvs. large and often docklike, variously dissected; fls. white, small, sepals and petals 4; fr. a globose to ellipsoidal silicle.

One species is widely grown as a condiment plant, the fleshy roots being grated for use as a pungent relish or appetizer with meats. Does not mature viable seeds; propagated by root cuttings planted in spring, and best treated as an annual crop, the roots harvested in late autumn of the same year.

rusticana P. Gaertn., B. Mey. & Scherb. [*Cochlearia Armoracia* L.; *Nasturtium Armoracia* (L.) Fries; *Radicula Armoracia* (L.) B. L. Robinson; *Rorippa Armoracia* (L.) A. S. Hitchc.]. HORSERADISH, RED COLE. Deep-rooted, strong per.; lower lf. blades to 15 in. long and 9 in. across, crenate-dentate or jagged, sometimes dissected into linear segms., upper st. lvs. lanceolate to oblong; fls. in terminal panicle. Spring. Se. Eur., naturalized in N. Amer.

ARNEBIA Forssk. *Boraginaceae.* Not cult. A. Echioides: *Echioides longiflorum.*

ARNICA L. *Compositae* (Senecio Tribe). About 30 spp. of rhizomatous, pubescent and also usually glandular per. herbs, native to Eur., Asia, and N. Amer., sts. simple or branched above; lvs. opp.; fl. heads radiate or discoid, 1 to several, rather large, long-peduncled, involucral bracts in 2 rows, herbaceous; disc and ray fls. yellow; achenes slender, cylindrical, pappus of minutely barbed or almost plumose bristles.

Arnicas are grown in the rock garden or border or are colonized in woodsy places. Tincture of arnica, derived from *A. montana*, has medicinal uses. Propagated by seeds or division.

alpina (L.) Olin. To 4–15 in.; st. lvs. 1–4 pairs, lanceolate or oblanceolate, to 4–5 in. long, nearly entire, sessile or the lowermost petioled; heads usually solitary, to 2 in. across, involucre woolly; anthers yellow; pappus white. Circumboreal.

amplexicaulis Nutt. To 2 ft., viscid; st. lvs. 4–10 pairs, ovate to broadly elliptic-lanceolate, to 5 in. long, serrate-dentate, sessile; heads 3–9, 1⅛ in. across; anthers yellow; pappus tan. W. U.S. to Alaska.

betonicifolia: *A. latifolia.*

Chamissonis Less. To 2 ft.; st. lvs. 5–8 pairs, lanceolate-oblong to oblanceolate, to 6 in. long, denticulate or dentate, all sessile and clasping, or the lower ones short-petioled; heads 3–9, 2 in. across; anthers yellow; pappus tan. Nw. U.S. to s. Alaska. Subsp. foliosa (Nutt.) Maguire [*A. foliosa* Nutt.]. Lvs. usually entire, the lower ones distinctly petioled. Wyo. and Colo., w. to Calif. and Canada.

Clusii: *Doronicum Clusii.*

cordifolia Hook. To 18 in.; st. lvs. 2–3 pairs, the lower broad-lanceolate to ovate, cordate, long-petioled, mostly coarsely dentate, blades 2–3 in. long, the upper reduced, ovate or lanceolate, sessile; heads solitary, or sometimes 3, 2–3 in. across; anthers yellow; achenes pubescent their whole length, pappus white. S. Dak. to New Mex., w. to Calif., n. to Yukon, also n. Mich. The most desirable sp.

foliosa: *A. Chamissonis* subsp.

fulgens Pursh [*A. pedunculata* Rydb.]. Rhizomes short, rooting, with tufts of tan hairs in axils of old lf. bases, sts. 1–2 ft.; st. lvs. 4 or 5 pairs, oblanceolate, the lower crowded near base, petioled, to 6 in. long, nearly entire, the upper much-reduced, sessile; heads usually solitary, 2–3 in. across; anthers yellow; pappus whitish or light tan. B.C. to Sask., s. to n. Calif. and Colo.

latifolia Bong. [*A. betonicifolia* Greene]. To 2 ft.; st. lvs. 2–4 pairs, ovate to elliptic-lanceolate, 1–3 in. long, dentate, all sessile or the lowermost petioled; heads mostly 1–3; anthers yellow; achenes glabrous or hirsute only in upper half, pappus white. Wyo. and Colo., w. to Calif., n. to s. Alaska.

Lessingii Greene. To 10 in., without glands; lvs. 4–5 pairs in a rosette toward base of st., lanceolate or oblanceolate, 2–4 in. long, entire or denticulate, sessile or short-petioled; heads solitary, nodding, 2 in. across; anthers purple; pappus tan. Alaska, Kamchatka.

longifolia D. C. Eat. Sts. in clumps, to 2 ft.; st. lvs. 5–7 pairs, lanceolate to lanceolate-elliptic, to 4 in. long, entire or denticulate, viscid, sessile; heads 7–30, to 2 in. across; anthers yellow; pappus straw-colored or tan. Mts., Calif. and Colo., n. to Wash. and Mont.

mollis Hook. To 2 ft.; st. lvs. 2–4 pairs, ovate, lanceolate, obovate, or oblanceolate, to 6 in. long, denticulate, sessile or the lower ones petioled; heads mostly 1–3, to about 3 in. across; anthers yellow; pappus tan. Colo. to Calif., n. into Canada, also N.Y. and New Eng. to Gaspé Pen.

montana L. To 2 ft.; st. lvs. about 3 pairs, broadly lanceolate, ovate, or obovate, entire or obscurely denticulate, sessile, upper pair much reduced, the others in a basal rosette, to 5 in. long; heads 1–3 or more, to 3 in. across; anthers yellow; pappus tan. Cent. Eur., s. Scandinavia.

pedunculata: *A. fulgens.*

sachalinensis (Regel) A. Gray. Nearly glabrous, 12–30 in.; st. lvs. 12–20 pairs, lanceolate or oblanceolate, to 6 in. long, serrate, sessile and united; heads 5–15, to 2¼ in. across; anthers purple; pappus tan. Sakhalin Is.

saluensis: a listed name; perhaps for *A. sachalinensis.*

unalaschcensis Less. To 3–12 in.; st. lvs. 3–5 pairs, mostly broadly lanceolate or oblanceolate, to 4 in. long, serrulate, the upper sessile, the lower petioled; heads solitary, about 1¼ in. across; corolla tube glabrous, anthers purple; pappus tan. Japan and islands of Bering Sea. Var. Tschonoskyi (Iljin) Kitam. & Hara. Corolla tube pubescent. Japan.

ARONIA Medic. CHOKEBERRY. *Rosaceae.* A few spp. of low, deciduous shrubs of N. Amer.; lvs. alt., simple, short-petioled, finely serrate; fls. small, pink or white, in terminal cymes, calyx tube urceolate, sepals 5, petals 5, concave, spreading, styles 3–5, united at base; fr. a small berrylike pome. Often considered a subgenus of *Pyrus.*

Propagated by seeds sown when ripe or stratified, and by suckers, layers, and cuttings of green wood under glass. Useful for colonizing in low places; showy in bloom and the fruit attractive in autumn.

arbutifolia (L.) Pers. [*Pyrus arbutifolia* (L.) L.f.]. CHOKEBERRY, RED C. Shrub, tending to form colonies, to 12 ft. or more, young growth tomentose; lvs. broadly oblanceolate to wider, pointed, green and glabrous above, tomentose and pale beneath, crenate-serrate, 1–3¼ in. long; fls. 2–25, about ⅝ in. across, calyx tube tomentose, sepals with stipitate glands; fr. red, ⅜ in. in diam. Nov. Sc. to Ont., Mich., s. to Tex., Fla. Zone 6.

atropurpurea: *A. prunifolia.*

floribunda: *A. prunifolia.*

melanocarpa (Michx.) Elliott [*A. nigra* (Sarg.) Koehne; *Pyrus melanocarpa* (Michx.) Willd.]. Like *A. arbutifolia*, but young twigs, lower lf. surfaces, and calyx tube glabrous, sepals essentially glabrous; fr. black, ⅜ in. in diam. Nfld. to Minn., S.C., Tenn.

nigra: *A. melanocarpa.*

prunifolia (Marsh.) Rehd. [*A. floribunda* (Lindl.) Spach; *Pyrus atropurpurea* (Britt.) L. H. Bailey]. Like *A. arbutifolia*, but sepals glandless or nearly so; fr. purple or purple-black, ⅜ in. in diam. Nfld. to Ont., s. to Va. and Ind. Zone 5.

cucullata (L.) R. Br. Pseudobulbs cylindrical, with a bulbous thickening at base, lvs. filiform, cylindrical, fleshy, to 1 ft. long; fls. 1–2 on peduncles to 6 in. long, sepals and petals white to greenish-white, aging to yellowish, spreading and pendulous, linear, acuminate, to 3 in. long, lip to 3 in. long, white-short-clawed, semicircular, with finely toothed margins, apically prolonged into a slender, acuminate lobe. Late spring–early winter. Trop. Amer.

Digbyana Lindl. [*Laelia Digbyana* (Lindl.) Benth.; *Rhyncholaelia Digbyana* (Lindl.) Schlechter]. Pseudobulbs elongated, jointed, club-shaped; lvs. leathery, elliptic, glaucous-green, to 8 in. long; infl. 1-fld.; fl. showy, fragrant, 4–6 in. across, sepals and petals elliptic, pale green-yellow, lip large, 3 in. long, obscurely 3-lobed, nearly orbicular, involute at base and enveloping column, cream-white with greenish suffusion, upper margins deeply lacerate-fringed, disc with several fleshy ridges. Spring–summer. Cent. Amer. Frequently used as a parent in crosses with spp. and cvs. of *Cattleya*, *Laelia*, and *Sophronitis*, the resultant hybrids possessing large, fringed lips.

fragrans Barb.-Rodr. To 20 in.; lvs. fleshy, cylindrical; raceme much shorter than lf., few-fld., flexuous; fls. fragrant, yellowish-white, with a few purple spots, to 2 in. long, sepals and petals filiform, lip recurved, somewhat shorter than sepals. Autumn. Brazil.

glauca Lindl. [*Laelia glauca* (Lindl.) Benth; *Rhyncholaelia glauca* (Lindl.) Schlechter]. Pseudobulbs club-shaped, to 4 in. long; lvs. leathery, oblong-elliptic, glaucous, to 5 in. long; fls. solitary, nodding, fragrant, on peduncle 4 in. long, sepals linear-elliptic, to 2¼ in. long, olive-green to white or lavender, petals similar to sepals in shape and length, olive-green to whitish, lip to 2 in. long, white or yellowish with rose-pink spot over several reddish stripes in throat, 3-lobed, midlobe squarish-oblong, apiculate at apex. Winter–early spring. Cent. Amer.

nodosa (L.) Lindl. LADY-OF-THE-NIGHT. Pseudobulbs 1–4 ½ in. long; lvs. to 9 in. long; fls. solitary, short-peduncled, sepals and petals linear, to 3 in. long, greenish-yellow or white, lip white, not toothed. Winter. W. Indies. Cent. Amer., Colombia, Venezuela, Surinam.

Perrinii Lindl. To 10 in., with ascending rhizome; lvs. fleshy, cylindrical; peduncle shorter than lf., 1-fld.; fls. to 2 in. long, sepals and petals greenish-yellow, spreading, filiform, lip white, with yellow-green throat, ovate, short-clawed, acute at apex. Brazil, Paraguay.

BRASSIA R. Br. *Orchidaceae*. About 50 spp. of epiphytes, native to trop. Amer.; pseudobulbs 1–3-lvd.; fls. in lateral racemes, sepals and petals narrow, long-pointed, often tail-like, lip entire, shorter than sepals. For structure of fl. see *Orchidaceae*.

Intermediate greenhouse; for culture see *Orchids*.

Allenii L. O. Williams ex C. Schweinf. Pseudobulbs not developed; lvs. many, forming a broad fan, to 1 ft. long; raceme several-fld., from lf. axils, shorter than lvs.; fls. fragrant, sepals and petals similar, spreading, reddish-tan to olive-ochre, 1½ in. long, linear-lanceolate, lip nearly orbicular, yellow, with band of reddish-tan and a white disc, cuspidate at apex. Autumn. Panama.

brachiata: *B. verrucosa*.

caudata (L.) Lindl. Pseudobulbs to 6 in. long; lvs. oblong or oblong-elliptic, to 11 in. long, acute; infl. to 1¼ ft. long, 6–15-fld.; sepals and petals greenish-yellow, with brown spots on basal half, lateral sepals to 6 in. long, petals to 1 in. long, lip light yellow with brown spots, with 2 small teeth at apex of callus. Winter–late summer. Trop. Amer., from Fla. to S. Amer.

chlorops Endres & Rchb.f. To 1 ft.; lvs. lanceolate; infl. to 10 in. long, shorter than lvs., loosely few-fld.; fls. small, ¾ in. long, greenish, sepals and petals lanceolate, acuminate, lip linear-lanceolate, with 2 pubescent keels at base. Costa Rica, Panama, Colombia.

Gireoudiana Rchb.f. & Warsz. Pseudobulbs to 5 in. long, 2-lvd.; lvs. oblong or elliptic-oblong, to over 17 in. long; infl. over 2 ft. long, usually 7–10-fld.; sepals linear-lanceolate, to 6 in. long, tapering, cream-colored or greenish-yellow, spotted with brown on basal ½, petals to 2¼ in. long, yellow, spotted with brown on lower half, lip light yellow, spotted with brown. Early winter–late spring. Costa Rica, Panama.

guttata: *B. maculata*.

Keiliana Rchb.f. ex Lindl. Pseudobulbs much-compressed, to 2 in. long, 1-lvd.; lvs. narrowly ovate, strap-shaped, to 10 in. long; infl. as long as lvs. or longer, few- or many-fld., fl. bracts as long as pedicelled ovary or longer; fls. yellow, spotted with brown, sepals to 3 in. long, petals to 1¾ in. long, lip whitish. Late spring. Colombia, Venezuela.

Lanceana Lindl. [*B. pumila* Lindl.]. Pseudobulbs strongly flattened, 1–3-lvd.; lvs. lanceolate-oblong, to 12 in. long; infl. longer than lvs., densely many-fld.; sepals and petals yellow, with brown markings, sepals 2¼ in. long, petals 1½ in. long, lip oblong-pandurate, yellowish-white, flecked with brown, acute, with a pair of white calluses at base. Surinam, Venezuela.

Lawrenceana Lindl. Pseudobulbs over 2 in. long, 2-lvd.; lvs. oblong or lanceolate, to 8 in. long; infl. to 2 ft. long or more; sepals and petals greenish- or bright yellow, spotted with brown, sepals almost 3 in. long, petals 1¼ in. long, lip light yellow, without flecks. Late spring. Guyana, Surinam. Var. longissima: *B. longissima*.

longissima (Rchb.f.) Nash [*B. Lawrenceana* var. *longissima* Rchb.f.]. Pseudobulbs to 5 in. long, 1- or 2-lvd.; lvs. to 15 in. long and 2¼ in. wide; infl. to 2 ft. long, 10–15-fld.; sepals and petals golden-yellow or greenish-yellow, spotted with brown at base, lateral sepals to 12 in. long, petals about 3 in. long, lip acuminate, pale yellow or white, spotted with red-brown. Late winter–autumn. Costa Rica.

maculata R. Br. [*B. guttata* Lindl.]. Differs from *B. longissima* in having lateral sepals only 2–3 in. long, petals smaller, and lip much broader, acute. Spring–summer, autumn. W. Indies and Cent. Amer.

pumila: *B. Lanceana*.

verrucosa Batem. [*B. brachiata* Lindl.]. Pseudobulbs to 3 in. long or more, 2-lvd.; lvs. oblong or elliptic-oblong, to 1 ft. long; infl. to about 2¼ ft. long, 4–16-fld.; sepals and petals green or yellowish, spotted with brown at base, sepals 3–5 in. long, petals to 2 in. long, lip white, warty, spotted with dark green toward base. Spring–early summer. Mex., Guatemala, Honduras, Venezuela.

BRASSICA L. [*Sinapis* L.]. COLE, MUSTARD. *Cruciferae*. Probably more than 40 spp. of mostly ann., bien., or sometimes per. herbs or small shrubs of Old World origin, but the nativity of many unknown; plants erect, tall, branched, and for the most part glabrous, often glaucous; lower lvs. variously pinnatifid or lyrate or strongly toothed; fls. in terminal racemes, yellow, yellowish-white or sometimes white, sepals 4, petals 4, clawed, lateral nectaries prismatic, deep green; fr. an elongate silique, valves convex, with prominent midvein.

acephala: *B. oleracea*, Acephala Group.

alba: *B. hirta*.

alboglabra: *B. oleracea*, Alboglabra Group.

arvensis: *B. Kaber*.

botrytis: *B. oleracea*, Botrytis Group.

bullata: see *B. oleracea*, Capitata Group.

campestris: *B. Rapa*.

capitata: *B. oleracea*, Capitata Group.

cauliflora: *B. oleracea*, Botrytis Group.

caulorapa: *B. oleracea*, Gongylodes Group.

chinensis: *B. Rapa*, Chinensis Group.

fimbriata: *B. Napus*, Pabularia Group.

gemmifera: *B. oleracea*, Gemmifera Group.

hirta Moench [*B. alba* (L.) Rabenh., not Gilib.; *Sinapis alba* L.]. WHITE M. Ann., to 4 ft., sparsely hairy; lvs. elliptic to obovate, deeply divided at the sides; fls. yellow, about ½ in. long; siliques spreading, to 1½ in. long, lower part seed-bearing and noduloso, beak flat. Medit. region, w. Asia; naturalized in N. Amer. Cult. for its mustard- and oil-producing seeds, also for greens.

japonica: *B. juncea* var.

juncea (L.) Czernisk. [*B. rugosa* Hort.; *Sinapis juncea* L.]. BROWN M., INDIAN M., LEAF M., MUSTARD GREENS. Ann., to 4 ft., green but st. sometimes slightly glaucous; lower lvs. elliptic to obovate, lyrate-lobed or divided, toothed or scalloped, rather thin, st.-lvs. narrowed at base but not clasping; fls. bright yellow; siliques to 1½ in. long. Eur., Asia. Much cult. for spring greens and as an oilseed, also spontaneous and a weed in N. Amer. Var. crispifolia L. H. Bailey [*B. japonica* Hort., not Thunb.]. CURLED M., SOUTHERN C. M., OSTRICH-PLUME. Lvs. cut, curled, crisped. The commonest leaf mustard for greens. Var. foliosa L. H. Bailey. BROAD-LEAVED M. Lvs. very large. Grown for greens. Var. longidens L. H. Bailey. Lvs. long, narrow, with large, prongilke teeth. Var. multisecta L. H. Bailey. Lvs. finely divided. See *Mustard*.

Kaber (DC.) Wheeler [*B. arvensis* (L.) Rabenh., not L.; *Sinapis arvensis* L.; *S. Kaber* DC.]. CHARLOCK, CALIFORNIA RAPE. Ann., to 3 ft. or more, green, commonly hispid toward base and sometimes above; lvs. ovate to oblong-ovate, variously lobed or lyrate, not clasping; fls. yellow, small; siliques about ¾ in. long or less, noduloso, beak often ½ in. long or more. Probably native in Medit. region. Sometimes cult. for mustard, but seeds not pungent; an early-flowering weed of waste places and grain fields.

Napobrassica: *B. Napus*, Napobrassica Group.

Napus L. RAPE. COLZA. Ann., but late-sown plants overwintering and flowering the following spring, making thin taproot; lvs. glaucous, lower lvs. lyrate-pinnatifid, sparsely bristly, petioled, middle and upper lvs. oblong-lanceolate, thick, clasping and sessile; fls. pale yellow; siliques to 4¼ in. long, ascending, on rather slender pedicels, beak to 1 in. long. Nativity unknown. In N. Amer. sown late as a forage and cover crop for late autumn and early spring. Elsewhere ann. or summer races of rape are grown for the seed, used for oil and as birdseed. See *Rapa*.

Napobrassica Group (*B. Napobrassica* Mill.; *B. Napobrassica* var. *solidiflora* L. H. Bailey). RUTABAGA. SWEDE. SWEDISH TURNIP. Thickened root with solid yellow or white flesh and with long neck or crown often withstanding winter in the North; siliques much spreading, on short pedicels, the beak short, stout. See *Rutabaga*.

Pabularia Group (*B. fimbriata* (Mill.) DC., *B. oleracea* var. *fimbriata* Mill.). SIBERIAN KALE. HANOVER SALAD. Low, dwarf bien., producing much edible herbage for winter and spring use, then going to seed; lvs. oblong or narrower, deeply lobed at the sides, curled or fringed, glaucous-blue, sometimes purplish. See *Kale*.

narinosa L. H. Bailey. BROAD-BEAKED M. Stout, low, bien., glabrous, not glaucous; lower lvs. in short clusters, orbicular-ovate, small, mostly entire, puckered, petioles broad, white, st. lvs. very broad, entire, clasping; fls. yellow; siliques very thick, ¾ in. long or less, ¼ or ⅓ as broad, beak very short, stout. Probably Asia. Grown as a potherb by Chinese.

nigra (L.) W. D. J. Koch (*Sinapis nigra* L.). BLACK M. Much-branched ann., to 6 ft. and more, mostly hispid-hairy at least below, green, little if at all glaucous; lvs. pinnatifid to lyrate, dentate, petioled; fls. yellow, in many short racemes; siliques appressed to rachis, 1 in. long or less, 4-sided. Eurasia. Widespread weed; cult. as a main source of pungent table mustard.

oleracea L. WILD CABBAGE. Stout ann. to per., sometimes bien., glabrous, glaucous; lvs. thick, lower lvs. rounded or obovate, to 20 in. long, lobed at base, st. lvs. narrow, long, sometimes clasping; fls. whitish-yellow or cream-yellow, to 1 in. long; siliques spreading, to 4 in. long, seeds large, round. Coastal, w. and s. Eur. Represented in cult. by many forms, including several common vegetables. All forms, herein assigned to groups, have similar cult. requirements, including a cool growing season and deep, fertile soil capable of holding abundant moisture. Var. fimbriata: *B. Napus*, Pabularia Group.

Acephala Group (var. *acephala* DC.; *B. acephala* of auth.). KALE. TALL K. CABBAGE K. TREE K. DECORATIVE K. FLOWERING K. KITCHEN K. ORNAMENTAL K. ORNAMENTAL-LEAVED K. SCOTCH M. FLOWERING CABBAGE. COW C. COLLARDS. COLE. COLEWORT. BORECOLE. BRASCHETTE. St. usually unbranched, lvs. separate or only in loose rosettes, not making solid heads, thick, glaucous. The kales are planted in late spring or in late summer to produce either an autumn or early spring crop. Where winters are mild the plants may stand for a year or more. The ornamental kale, with rosettes of variously colored white, pink, or purplish lvs., often with fringed margins, is similarly planted from seed to produce autumn or winter bedding plants. See *Collard* and *Kale*.

Alboglabra Group (var. *alboglabra* (L. H. Bailey) Musil; *B. alboglabra* L. H. Bailey). CHINESE KALE. Ann., sometimes overwintering, to 3 ft., glabrous, very glaucous; lvs. thick, lower lvs. elliptic, to 10 in. long, sinuate, upper st. lvs. long-oblong and petioled or at least not clasping; fls. white; siliques 2–3 in. long. Probably native to Asia, where grown as a potherb.

Botrytis Group (var. *botrytis* L.; *B. botrytis* (L.) Mill.; *B. cauliflora* Gars.). BROCCOLI. CAULIFLOWER. Low, with stout, short st.; infl. a dense, terminal head formed of thickened, modified fl. clusters overtopped by lvs. Cult. of cauliflower and broccoli is similar to that of cabbage, but the plants are more tender to frost and less tolerant of heat and dryness. Broccoli requires a longer growing season than cauliflower. See *Broccoli* and *Cauliflower*.

Capitata Group (var. *capitata* L.; *B. capitata* of auth.). CABBAGE. HEAD C. Low, with stout, short st., bearing dense, terminal head of lvs. In one form, the SAVOY CABBAGE (var. *bullata* DC.; *B. bullata* of auth.), the lvs. are blistered and puckered. Cvs. differ in season of maturity and in color, size, and shape of the head. In all stages of development they withstand considerable frost, although young plants from hotbeds must be hardened off. See *Cabbage*.

Gemmifera Group (var. *gemmifera* Zenk.; *B. gemmifera* of auth.). SPROUTS. BRUSSELS S. St. simple, erect, to 3 ft., with small, compact, edible buds. See *Brussels sprouts*.

Gongylodes Group (*B. caulorapa* Pasq.). KOHLRABI. Low, stout bien., st. enlarging just above ground into a turniplike, edible tuber; lvs. elliptic, 10 in. long or less, long-petioled; fls. cream-yellow; siliques 2–3 in. long, beak short, thick. There are green- and purplish-stemmed cvs. Cult. as for turnips. Tubers should be harvested when 2 or 3 in. in diam. See *Kohlrabi*.

Italica Group (var. *italica* Plenck). ITALIAN BROCCOLI. ASPARAGUS B., SPROUTING B. Differs from Botrytis Group in the fl. brs. thickened, but not condensed into a solid head.

Tronchuda Group (var. *Tronchuda* L. H. Bailey). TRONCHUDA KALE. PORTUGUESE K., TRONCHUDA CABBAGE. PORTUGUESE C. Low, cabbagelike plant, without compact heads of lvs., with fleshy petiole and broad midribs. Lvs. used much like celery.

parachinensis L. H. Bailey. FALSE PAK-CHOI. Like *B. Rapa*, Chinese Group, but with basal lvs. more nearly orbicular, petiole not margined, and st. lvs. narrowed to base, not clasping. Probably e. Asia. Grown by Chinese as a potherb.

pekinensis: *B. Rapa*, Pekinensis Group.

perviridis: *B. Rapa*, Perviridis Group.

Rapa L. (*B. campestris* L.). FIELD M. Ann. or bien., root flat or globose, without a long neck or crown; lvs. lyrate-pinnatifid, to 20 in. long, soft but hispid, clasping; fls. yellow; siliques 2½ in. long or less. Eur. Var. lonifolia: Rapifera Group. Var. sepiceps: Rapifera Group. See *Mustard*.

Chinensis Group (*B. chinensis* L.). PAK-CHOI. CELERY MUSTARD CHINESE M. Ann. or bien., glabrous, somewhat glaucous at maturity; lower lvs. glossy, making a rather compact cluster to 20 in. high, but not a head, obovate, entire or nearly so, petiole thickened, succulent, white, narrowly winged or margined but not jagged, st. lvs. clasping; fls. pale yellow, ¾ in. long; siliques to 2½ in. long. In habit of growth resembling garden celery or chard. Much cult. in Asia for its succulent lvs.

Pekinensis Group (*B. pekinensis* (Lour.) Rupr.). PE-TSAI. CHINESE CABBAGE. CELERY C. Ann., glabrous or essentially so; lvs. soft, green, basal lvs. large, very broad, undulate or obscurely toothed, petiole broad, flat, with jagged wings, st. lvs. petioled or clasping; fls. light yellow; siliques 2½ in. long. Grown as a cool-season vegetable, the lvs. forming a more or less solid head.

Perviridis Group (var. *perviridis* L. H. Bailey; *B. perviridis* (L. H. Bailey) L. H. Bailey). TENDERGREEN. SPINACH M. Ann. or perhaps bien., to 6 ft. in fr., branching above; lower lvs. many, spatulate-oblong, nearly entire, glossy green, tender, petiole not lobed; seeds small, somewhat angled. Grown in N. Amer. for its edible foliage, but the thick, tuberous crown to 3 in. across, pickled in Asia.

Rapifera Group (var. *lonifolia* L. H. Bailey; var. *sepiceps* L. H. Bailey; *B. sepiceps* (L. H. Bailey) L. H. Bailey). TURNIP. SEVEN-TOP T., RAPINI. Stout bien., glaucous, very leafy and florferous, with several tall sts. from root crown; lower lvs. with few deep lobes, st. lvs. clasping; fls. small, in short clusters; seeds small, angled or irregular. One of the oldest root crops. Turnips are short-season plants for cool climates. The roots are many sizes and shapes, with white or yellow flesh. Growing shoots used as greens. For use as a salad plant it is usually sown in late summer and early autumn. Sometimes called BROCCOLI or ITALIAN KALE. See *Turnip*.

Ruvo Group (*B. Ruvo* L. H. Bailey). RUVO KALE. TURNIP BROCCOLI. ITALIAN TURNIP. BROCCOLI RAAB. Ann. if sown in spring, bien. if sown in autumn, 2½–3½ ft. at maturity, with taproot; lvs. lyrate-pinnatifid, with lobes on petioles, dark green, often glossy; fls. small, in close clusters; siliques small, about 2 in. long. Not to be confused with Italian broccoli, *B. oleracea*, Italica Group.

rugosa: *B. juncea*.

Ruvo: *B. Rapa*, Ruvo Group.

sepiceps: *B. Rapa*, Rapifera Group.

BRASSICACEAE: see *CRUCIFERAE*.

BRASSIOPHOENIX Burret. *Palmae*. Two spp. of solitary, unarmed, monoecious palms of New Guinea; lvs. pinnate, sheaths tubular, forming a prominent crownshaft, pinnae cuneate, 3-pronged at apex with prominent midrib and marginal veins; infl. below lvs., somewhat long-peduncled, bracts 2, the upper protruding from the lower in bud, rachillae with fls. in triads (2 male and 1 female); male fls. symmetrical, sepals 3, imbricate, petals 3, valvate, stamens many, anthers attached by base, pistillode shorter than the stamens, female fls. with sepals and petals imbricate, staminodes about 6, small, dentiform, pistil ovoid, 1-celled, 1-ovuled; fr. ovoid with terminal stigmatic residue, scarlet or yellowish-orange, endocarp hard, 3- or 9-ribbed, seed 3-sulcate, endosperm homogeneous.

For culture see *Palms*.

Schumannii (Becc.) Essig. To 30 ft.; lvs. 5–9 ft. long, rachis conspicuously dark-scaly, pinnae 9–10 on each side; infl. stout, few-branched, dark scaly; fls. cream-colored, male buds ⅛–¼ in. long; fr. yellowish-orange, 1½–1¾ in. long.

long, petals cream-colored, 1/16 in. long. Mex. Var. Stansburiana (Torr.) Jeps. Bark grayish. lf. blades toothed. E. Calif. to Colo. and New Mex. Zone 6.

COXELLA: *ACIPHYLLA*.

CRABAPPLE: see *Apple*.

CRAIBIA Harms & S. T. Dunn. *Leguminosae* (subfamily *Faboideae*. About 10 spp. of trees and shrubs of trop. Afr.; lvs. alt., odd-pinnate or with 1 lft., the lfts. alt.; fls. racemose or panicled, often white, upper 2 calyx lobes united, stamens 10, 9 united and 1 free; fr. an ovate to oblong-obovate, flat legume, early dehiscent, seeds 1–2.

Brownii S. T. Dunn (*C. Elliotii* S. T. Dunn). Slow-growing tree, to 40 ft., with large spreading crown; lfts. 3–7, elliptic, to 4 in. long, acuminate; fls. very fragrant, white or tinged pink, in terminal racemes to 3 in. long; fr. obovate, to 2¼ in. long, narrowed at each end, 1-seeded. Kenya.

Elliotii: *C. Brownii*.

CRAMBE L. *Cruciferae*. About 20 spp. of ann. to per. herbs, mostly from Canary Is. to w. Asia, sometimes woody at base, glabrous or with unbranched hairs; lvs. mostly thick or fleshy, glaucous, often very large, lobed, cut, lyrate, or pinnatifid; fls. small, many, in racemes or panicles, sepals 4, petals 4, white, with a short claw or wedge-shaped basally; fr. a 2-jointed indehiscent silicle, the upper joint 1-seeded and globular.

cordifolia Steven. COLEWORT. Stout per., to 7 ft.; basal lvs. cordate, to 2 ft. across and more, somewhat lobed and coarsely toothed, more or less hispid-hairy, long-petioled; fls. 1/16 in. across, in a great, terminal, leafless panicle. Caucasus. Grown as an ornamental because of its striking appearance.

maritima L. SEA KALE, SCURVY GRASS. Stout, stocky per., to 3 ft.; lvs. large, glaucous-blue, fleshy, brittle, basal lvs. to 2 ft. long or more and nearly as broad, notched and shallowly lobed, stout-petioled; fls. in panicles. Seacoasts, w. Eur. to Asia Minor. Grown for succulent spring shoots, which are blanched. See *Sea Kale*.

hispanica L. Slender ann., to 3 ft., usually densely hispid; lvs. with elliptic to nearly orbicular terminal segm., lobed or lyrate below, to 3 in. across, sinuate; fls. in long open racemes. Medit. region. Cult. as a commercial oilseed crop.

CRANBERRY. Native to North America, the cranberry, *Vaccinium macrocarpon*, is cultivated entirely in the United States and Canada. Leading states producing cranberries in developed bogs or swamps are Massachusetts, Wisconsin, New Jersey, Washington, and Oregon. Canada has a limited acreage in British Columbia, Quebec, and parts of Nova Scotia. The small or European cranberry, *Vaccinium Oxycoccos*, native in the northern parts of America, is not cultivated. The fruits of the mountain cranberry or lingenberry, *Vaccinium Vitis-idaea*, are often collected from the wild and marketed, especially in Europe.

The cranberry plant is a low-growing vine with persistent leaves and a shallow, fine, fibrous root system. In late summer flower buds are initiated near the end of shoots (uprights) that arise from the main runners and on which the fruit are borne the subsequent year. Adequate pollination is essential and bee colonies are generally brought into bogs during the flowering period.

The cranberry is restricted to acid soils of pH 3.2 to 4.5; alkaline peat and ordinary garden and farm soils are not suitable for its culture. A large supply of water is needed near the bogs for irrigation, as well as for flooding as a means of protection against winter injury, untimely frosts, and insects. All except the West Coast bogs need to be flooded in winter to prevent "winter killing," a grower's term for winter dessication, a killing of the plants caused by moisture loss from the leaves at a time when roots are in frozen ground. It is unnecessary and undesirable to flood higher than the tallest cranberry vines.

Because cranberry bogs are situated in the lower elevations of the landscape, they are more susceptible than most crops to frosts in spring and autumn, when, on clear, still nights, the heavier, cold air from surrounding uplands drains onto the bogs and stratifies, with the coldest layers at the base and warmer air above. Formerly it was customary to flood the bogs in anticipation of hazardous low temperatures, but since the mid-1960's some two-thirds of the cranberry acreage have been provided with low-gallonage sprinkler systems which provide almost instantaneous frost protection. Despite the development of sophisticated frost-warning systems, flooding the bogs is at best slow, requiring about 300,000 gallons per acre, and the onset of low temperatures frequently outpaced the protecting flood. With sprinklers, protection is assured with completion of the first rotation of the sprinkler heads, and protection continues as long as they are in operation.

Sprinklers are much more economical of water, most being designed to use about 50 gallons per acre per minute, an acre-inch being needed for all-night frost protection. They are infinitely more useful for summer irrigation than flooding and they have proved themselves efficient in the distribution of fungicides and insecticides.

New commercial bogs are developed in a series of beds about two acres in size and serviced by a single reservoir of water. The preparation and planting of a cranberry bog is an expensive and time-consuming operation. Existing vegetation and tree stumps must be removed and the peat leveled. Ditches must be dug around the swamp and at intervals through the bog to facilitate flooding and drainage. In most areas a few inches of sand is spread on the peat before spreading newly mown cuttings 3–4 inches long over the surface and "discing-in" with a simple machine looking like a disc harrow but with flat, blunt blades.

Rooted cuttings may also be planted at 12-inch spacings in and between rows. Then follows three or four years in which weed and insect control must be achieved before the first commercial harvest can be made. Every three to five years bogs are sanded with ¼ inch of sand in the autumn after harvest to provide a suitable medium for root growth and insect control. During the growing season the water table is maintained at 9–12 inches below the surface. With careful management, a cranberry bog may continue to produce an annual crop thereafter for a century or more.

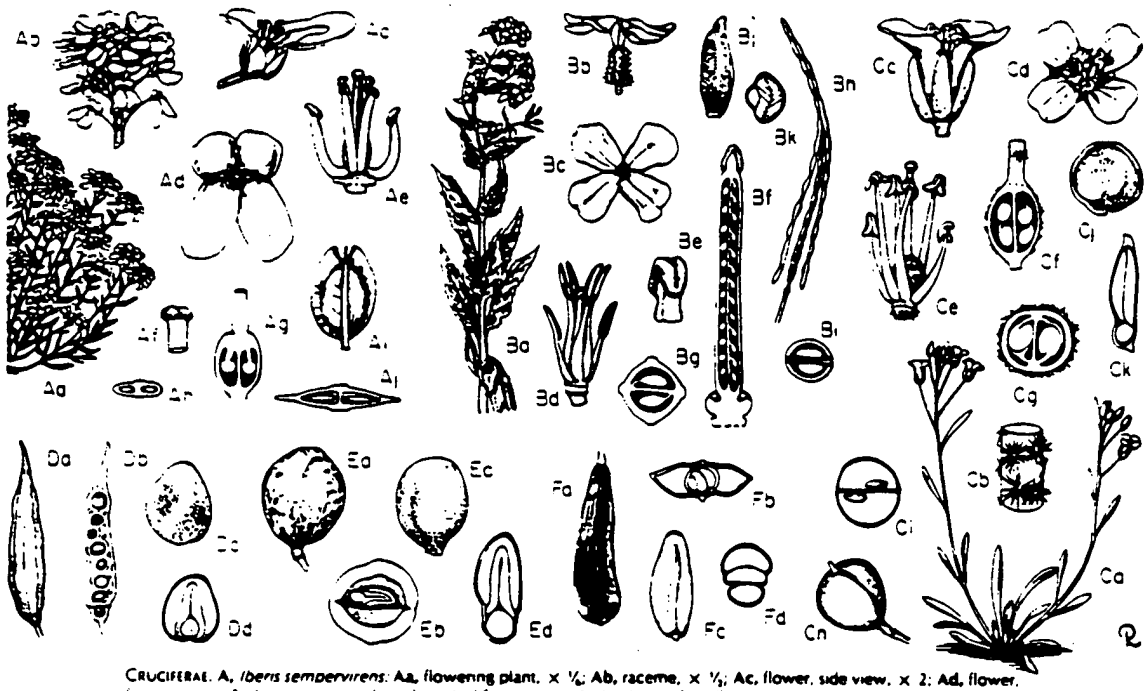
Because of high labor costs and a short harvesting season, cranberries are now largely harvested with special machines. Water harvesting, where the bog is flooded to a depth of 6–8 inches, is preferred over dry harvesting. The harvester rakes or beats the berries from the vines. These berries float to the surface and are gathered. Dry harvesting by mechanical means is less efficient because up to 30 percent of the crop is lost by berries dropping to the surface of the bog. Cranberries are now seldom harvested with hand scoops or by hand except occasionally for finishing up the margins of the bogs where it is difficult for machines to operate.

The average yield of an acre of cranberries is 100 barrels and occasional bogs will produce double that. Over half of all cranberries grown for processing are used in cranberry juices; the balance is made into sauces, relishes, and pie fillings. Only 20 percent of the cranberry crop is sold as fresh fruit.

Most of the annual crop is derived from named cultivars representing selections from wild cranberry vines. 'Early Black' and 'Howes' predominate in Massachusetts and New Jersey, 'Searless Jumbo' in Wisconsin, and 'McFarlin' in the Pacific Northwest. Hybrids derived from crosses of named selections are slowly being introduced, 'Stevens' being notable, particularly in Wisconsin.

The raising of cranberries is a highly specialized form of agriculture requiring heavy capital investment, daily surveillance of weather, insects, and other hazards, and in recent years the margin of profit has been narrow.

CRASPEDIA G. Forst. *Compositae* (Inula Tribe). About 7 spp. of ann. or per. herbs, native to Australia, New Zeal., and Tasmania; lvs. in a basal rosette or alt. on sts., entire; infl. a compound head composed of many 3–10-fld. individual heads crowded together in an ovoid or globose terminal clus-



CRUCIFERAE. A, *Iberis sempervirens*: Aa, flowering plant, × ⅙; Ab, raceme, × ⅓; Ac, flower, side view, × 2; Ad, flower, face view, × 2; Ae, stamens and pistil, × 4; Af, stigma, × 6; Ag, base of pistil, vertical section, × 6; Ah, ovary, cross section, × 6; Ai, fruit (a silicle), × 1; Aj, fruit, cross section, × 2. B, *Hesperis matronalis*: Ba, flowering stem, × ⅛; Bb, flower, side view, × ½; Bc, flower, face view, × ½; Bd, stamens and pistil, × 1½; Be, stigma, × 10; Bf, pistil, vertical section, × 5; Bg, ovary, cross section, × 15; Bh, fruit (a silique), × ½; Bi, fruit, cross section, × 2; Bj, seed, × 5; Bk, seed, cross section (cotyledons incumbent), × 6. C, *Lesquerella alpina*: Ca, flowering plant, × ½; Cb, segment of stem with stellate hairs, × 10; Cc, flower, side view, × 2; Cd, flower, face view, × 2; Ce, stamens and pistil, × 3; Cf, base of pistil, ovary in vertical section, × 6; Cg, ovary, cross section, × 10; Ch, fruit, × 1½; Ci, fruit, cross section, × 1½; Cj, seed, × 5; Ck, seed, cross section (cotyledons accumbent), × 8. D, *Raphanus sativus*: Da, fruit, × ½; Db, fruit, vertical section, × ½; Dc, seed, × 3; Dd, seed, cross section (cotyledons conduplicate), × 3. E, *Crambe maritima*: Ea, fruit, × 1½; Eb, fruit, cross section, × 1½; Ec, seed, × 2; Ed, seed, cross section (cotyledons conduplicate), × 3. F, *Isatis tinctoria*: Fa, fruit, × 1½; Fb, fruit, cross section, × 4; Fc, seed, × 5; Fd, seed, cross section (cotyledons incumbent), × 8.

of horticulture with variegated foliage belong to the genus *Codiaeum*. The following epithets sometimes, but incorrectly, used in *Croton* are properly treated as cultivars of *Codiaeum variegatum* var. *pictum*, and are listed under that name: *Andreanum, angustissimum, aniseumense, aucubifolium, bogoriense, bruxellense, Craigii, delicatissimum, edmontonense, glonosum, gracioseum, Grusonii, interruptum, linearis nigrescens, montefontainense, pictum, punctatum, punctatum aureum, Reidii, Sanderi, Schattii, spirale, Warrenii, Weismanii.*

macrostachys Hochst. ex A. Rich. Monoecious tree, to 30 ft. or more; lvs. ovate, 1½–4 in. long, cordate, crenulate; racemes usually unisexual, male to 10 in. long, many-fld., female to 4 in. long; female fls. without petals, male fls. with petals, stamens 15. S.-cent., se. and e. Afr.

megalobotrys Müll. Arg. Large, dioecious tree, 20–30 ft.; lvs. ovate to ovate-lanceolate, 1½–3 in. long, long-acuminate, rounded or truncate, serrate to dentate; male fls. with petals, many, in 1–3 in. racemes on short lateral branchlets, stamens 20–25. Se. and s.-cent. Afr.

megalocarpus Hutch. Monoecious tree, 70–80 ft.; lvs. oblong-lanceolate or elliptic-oblong, to 5 in. long, entire, densely scaly below; fls. with petals, in racemes, to 10 in. long, female fls. below, male fls. above, stamens 25. Trop. Afr.

monanthogynus Michx. PRAIRIE TEA. Monoecious, glandular ann. to 2 ft., sts. often umbellately 3–4-forked in lower part; lvs. oblong to ovate, entire; male fls. with petals, stamens 3–8, female fls. without petals, ovary often with only 1 or 2 cells. Va. to Kans., s. to Ga., Tex., and Mex.

pictum. *Codiaeum variegatum* var.

CRUCIANELLA L. CROSSWORT. *Rubiaceae*. About 30 or more spp. of ann. or per. herbs or half-shrubs, with slender 4-angled sts., from Medit. region, w. to Iran and cent. Asia; upper lvs. opp., lacking stipules, lower lvs. whorled; fls. in spikes or clusters subtended by bracts, small, white, rosy or blue, 4–5-merous, corolla funnelform, tube long; fr. dry, dehiscent into 2 halves.

Grown in rock gardens, where they thrive in partial shade. Propagated by division and by seeds.

angustifolia L. Ann., to 1½ ft.; lvs. in whorls of 4–6, all linear-subulate, very scabrous, margins recurved; fls. white, minute. Cent. and s. Eur.

berbeoea Forssk. Ann., to 1 ft. or more; lvs. ovate-oblong or the upper linear; fls. in dense, linear spikes to 2 in. long. Egypt.

latifolia L. Ann., to 1½ ft.; lower lvs. obovate to oblong, upper lvs. linear-lanceolate; fls. whitish, in slender, linear spikes. S. Eur.

stylosa Trin. Prostrate ann., sts. to 9 in. long; lvs. in whorls of 8–9, lanceolate, to ¾ in. long; fls. deep rose, in globose heads ⅛ in. across, styles long-exserted. Iran. Cv. 'Carminea' is listed.

CRUCIFERAE Juss. or, alternatively, **BRASSICACEAE** Burnett. MUSTARD FAMILY. Dicot.; about 350 genera and 3,200 spp. of pungent or acrid herbs of various habit; lvs. alt., without stipules; fls. in terminal racemes or corymbs, usually bisexual, regular, sepals 4, deciduous, petals 4, their spreading limbs forming a cross, stamens 6, 2 of these shorter and inserted lower than the others, pistil of 2 carpels, ovary superior; fr. a 2-celled caps., varying in form (known as a silique when elongated or a silicle when short and broad) but usually opening by 2 valves from below, seeds without endosperm, filled by a large embryo curved or folded in various ways, yielding (along with the fr.) the important taxonomic characters of the family.

The cultivated genera are: *Aethionema, Alyssoides, Alyssum, Anastatica, Arabidopsis, Arabis, Armoracia, Aubrieta, Aurinia, Barbarea, Berteroa, Biscutella, Brassica, Bunias, Cardamine, Cheiranthus, Cochlearia, Crambe, Dentaria, Diplotaxis, Dithyrea, Draba, Eruca, Erysimum, Fibigia, Heliophila, Hesperis, Hugueninia, Hutchinsia, Iberis, Ionopsidium, Isatis, Kernera, Lepidium, Lesquerella, Lobularia,*

Lunaria, Malcolmia, Matthiola, Morisia, Nasturtium, Peltaria, Petrocallis, Phoenicaulis, Physaria, Raphanus, Roripa, Schivereckia, Schizopetalon, Sisymbrium, Smelowskia, Stanleya, Stenodraba, Subularia, Thelypodium, Thlaspi, and *Thysanocarpus.*

The mustard family includes many ornamental species. It is also the source of important vegetables, particularly in the genera *Brassica* broccoli, Brussels sprouts, cabbage, Chinese cabbage, kale, kohlrabi, rutabaga, turnip), *Lepidium* (cress), *Nasturtium* (watercress), and *Raphanus* (radish); of condiment-producing plants, such as the common horseradish (*Armoracia*), Japanese horseradish (*Wasabia japonica*), and mustard (*Brassica*), and of important oilseed plants (*Brassica, Crambe*)

CRUPINA Cass. *Compositae* (Carduus Tribe). Two or 3 spp. of ann. herbs, native to s. Eur. and w. Asia; lvs. pinnately dissected; fl. heads long-peduncled, involucral bracts acuminate, not spiny; fls. light purple, all tubular, few; pappus blackish-brown, in 2 rows, the outer of graduated bristles, the inner of scales.

vulgaris Cass. [*Centaurea Crupina* L.]. To 2 ft.; lowermost lvs. oblanceolate, to 6 in. long, entire or lobed, the rest smaller, cut into denticulate, linear segms.; heads ¾ in. long, 3–5-fld.; fls. not much longer than involucre. S. Eur.

CRUSEA Schlechtend. & Cham. *Rubiaceae.* About 13 spp. of usually low ann. or per. herbs, native to s. Ariz. and New Mex., s. to Mex. and Cent. Amer., with sts. cylindrical or sometimes more or less 4-angled; lvs. 4-ranked, ovate or lanceolate, conspicuously nerved, stipules united with petioles to form a sheath; fls. in heads surrounded by leaflike bracts, usually pink or violet, 4-merous, corolla funnelform, tube slender, lobes spreading; fr. longitudinally dehiscent into 2 dry, 1-seeded sections.

calocephala DC. [*C. violacea* Brongn. ex J. Neumann]. Per. or rarely ann., sts. usually decumbent, often rooting, cylindrical, hairy, erect sts. 4–10 in. or more; lvs. sessile, ovate, ¾–3½ in. long, with 6 veins parallel to midvein, stipules awned; fls. violet. Mex. and Cent. Amer.

violacea: *C. calocephala.*

CRYOPHYTUM: *MESEMBRYANTHEMUM.*

CRYOSOPHILA Blume [*Acanthorrhiza* H. Wendl.]. *Palmae.* A few spp. of small or medium palms with bisexual fls., in Mex., Cent. Amer. and n. S. Amer., root-spines closely covering the trunk at least towards the base; lvs. palmate, divided nearly to base at center and then into 1- to several-ribbed, acute segms. on each side, petiole with smooth margins; infl. among lvs., arched, with tomentose loosely sheathing bracts on peduncle, rachillae many; fls. solitary, creamy-white to purplish, sepals 3, briefly united basally, petals 3, imbricate, stamens 6, filaments united to the middle or above, carpels 3, with subulate styles; fr. yellowish to white, globose to pear-shaped or oblong, seed globose with homogeneous endosperm and no intrusion of the seed coat.

Several species planted as ornamentals. For culture see *Palms.*

argentea Bartlett. To nearly 20 ft.; lvs. to 3 ft. long, ribs about 44, blade divided to middle and into about 9 segms. on each side, lacking conspicuous cross-veinlets when dry; fr. about ½ in. in diam. Brit. Honduras, Guatemala.

nana (HBK) Blume ex Salomon [*Acanthorrhiza aculeata* (Liebm.) H. Wendl.]. Small tree to 15 ft., trunk gray with short spines to 1 in. long; lvs. green above, silvery beneath, lacking conspicuous cross-veinlets when dry, ribs to 50, segms. to 2 ft. long, 1 in. wide; infl. short, to 1 ft. long in fr., lower bracts to 6 in. long; stamens united nearly to apex; fr. globose, to ⅝ in. long. Calcareous mts., w. Mex. Warmest parts of Zone 9b in Fla. Sometimes confused with *C. Warscewiczii.*

Warscewiczii (H. Wendl.) Bartlett. To 20 ft. or more, trunk gray with long root-spines at base, becoming nearly smooth above in age; lvs. green above, silvery beneath, with conspicuous cross-veinlets when dry, segms. 50–60, to 3 ft. long, 1½ in. wide, 2–4-ribbed; infl. to 2 ft. long or more, lower bracts 8–10 in. long; stamens united about half their length; fr. globose to pear-shaped, to 1 in. long, white. Costa Rica to Panama. Cult. in s. Fla., often under the name *Acanthorrhiza aculeata.*

CRYPTANTHA Lehm. ex Fisch. & C. A. Mey. WHITE FORGET-ME-NOT. *Boraginaceae.* About 100 spp. of hispid or setose, ann. and per. herbs, mostly of w. N. Amer., but some native to w. and s. S. Amer.; lvs. simple, alt., entire; fls. white or rarely yellow, small, many, in bractless or bracted scorpioid spikes or racemes, rarely somewhat cymose-paniculate, calyx 5-lobed or -cleft, corolla 5-lobed, funnelform, corolla throat with scales, stamens 5, included; fr. of 1–4, erect, rough or smooth nutlets.

Rarely sown in the wild garden in the region where they grow.

intermedia (A. Gray) Greene. Much-branched, hispid ann., 1–1½ ft.; lvs. linear to lanceolate, to 1 in. long; infl. bractless; fls. white, to ⅛ in. across; nutlets usually 4, rough. N. Calif. to Baja Calif.

Sheldonii (Brand) Payson. Hairy per. with 1 or more ascending sts., to 10 in.; basal lvs. spatulate to oblanceolate, to 1½ in. long; infl. bracted, with many yellow hairs; fls. white, to ⅛ in. wide; nutlets 4, somewhat glossy, rough. E. Wash. and Ore. to Montana.

CRYPTANTHUS Klotzsch. EARTH-STAR. *Bromeliaceae.* About 20 spp. of terrestrial stoloniferous herbs, native to Brazil, usually with flattened rosettes of lvs., rarely with leafy sts.; lvs. stiff, prickly-margined; fls. white or greenish-white, borne in small heads among the foliage, inner fls. often sterile, sepals united into a tube, petals not appendaged, united into a tube, the lobes spreading, ovary inferior; fr. a berry, seeds without appendages.

Grown as foliage plants under glass, in the home, or outdoors in warm climates. Propagated by offsets; thrive in bright sun or filtered shade. For culture see *Bromeliaceae.*

Hybrids of several spp. are listed, the most common parents being *C. bahianus, C. Beuckeri,* and *C. zonatus. Cryptanthus Beuckeri* and *C. bahianus* have been crossed with spp. of *Billbergia* and the resulting hybrids are listed as × *Cryptbergia* or sometimes as × *Biltanthus.*

acaulis (Lindl.) Beer. STARFISH PLANT. Nearly stemless; lvs. elliptic-lanceolate, to 6 in. long, 1½ in. wide, with undulate, prickly margins, green, white-scurfy beneath; fls. 1⅝ in. long, tube of calyx much longer than the lobes, the lobes entire or nearly so. Small foliage plant with many cvs.: 'Rosso-pictus' is listed; 'Roseus', lvs. tinged rose-pink; 'Ruber' [var. *ruber* Hort. ex Beer], lvs. tinged red. Var. bromelioides *C. bromelioides.* Var. diversifolius: *C. diversifolius.*

bahianus L. B. Sm. St. long and leafy; lvs. narrowly triangular, to 10 in. long, ⅝ in. wide, with spines to ⅛ in. long, green and smooth above, becoming red-tinged, white-scurfy beneath; fls. to 1 in. long, petals white. Withstands full sun.

Bankeri: a listed name, probably in error for *C. Beuckeri.*

Beuckeri E. Morr. Lvs. to 5 in. long, 2 in. wide, narrowed to a petiole about 2 in. long, or the inner sessile and triangular, brownish-green or rosy-spotted, or striped with light green.

bivittatus (Hook.) Regel. Stemless or nearly so; lvs. strongly acuminate, arching, spiny, greenish-brown above, with 2 reddish or pink longitudinal stripes; fls. white. Cv. 'Luddemanii', of larger size. Cv. 'Minor', is listed.

bromelioides Otto & A. Dietr. [*C. acaulis* var. *bromelioides* (Otto & A. Dietr.) Mez]. PINK C. Lvs. all alike, not petioled, to 7 in. long, 1¾ in. wide, spiny-margined, green above, silvery beneath; infl. on a scape 6 in. high; fls. many, in clusters of 4–6 in axils of keeled fl. bracts, milky-white, 1⅝ in. long, tube of calyx longer than the lobes. Sometimes grown under the name *C. terminalis.* Var. tricolor M. B. Foster. RAINBOW-STAR. Lvs. striped with ivory-white and green, overlaid with carmine-rose.

diversifolius Beer [*C. acaulis* var. *diversifolius* (Beer) Mez]. Lvs. dimorphic, gradually narrowed at the base, to 1 ft. long, 1¾ in. wide, uniformly colored above and beneath; fl. bracts to ⅝ in. long; sepals acuminate.

Fosterianus L. B. Sm. Lvs. constricted at base, all alike, thick and fleshy, marked with irregular dark brown crossbands above; calyx ⅝ in. long.

Lacerdae Ant. SILVER-STAR. Small, stemless; lvs. all alike, not petioled, scarcely more than 2 in. long, ashy-white-scurfy but with 2 longitudinal, glabrous, green stripes; infl. few-fld.; fls. milky-white, ⅝ in. long.

× **Osyanus** hort. name for the hybrid, *C. Beuckeri* E. Morr. × *C. Lacerdae* Ant.

Racinae a listed name of no botanical standing.

rosso-pictus a listed name of no botanical standing; probably *C. acaulis* cv. or *C. bivittatus.*

roseus a listed name of no botanical standing; probably *C. acaulis* cv.

rubescens a listed name of no botanical standing.